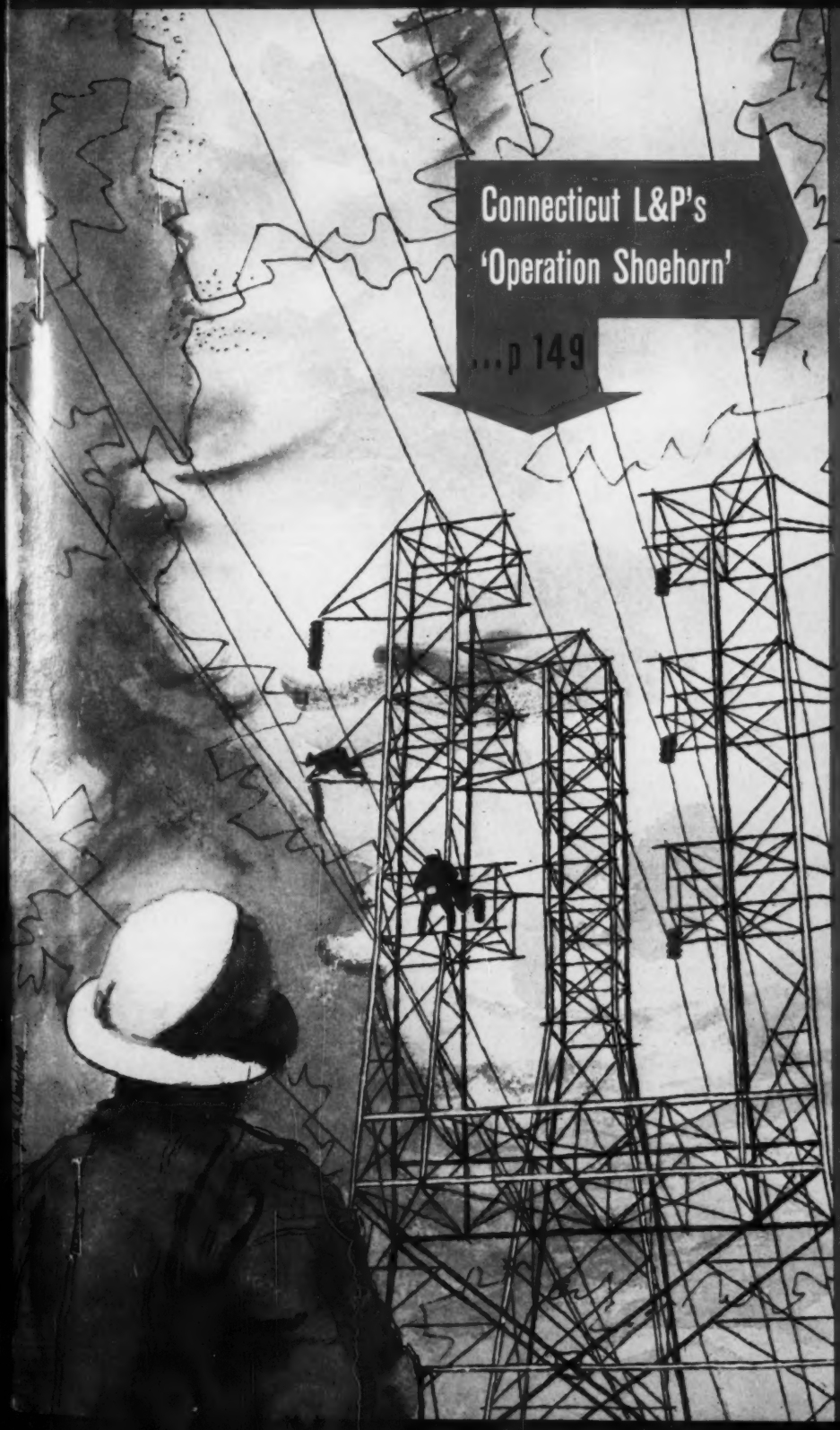
Electrical World

a quarterly special report



Connecticut L&P's 'Operation Shoehorn' ...p 149

starts on p 127

- Connecticut L&P construction crews squeeze four circuits for 115 kv into 80-ft R/W
- Outlining of coal with lime; rubber bag-water method checks Ohio Edison's coal supply
- Overhaul of waterwheel is aided by truth gages built by West Penn Power Co

Features:

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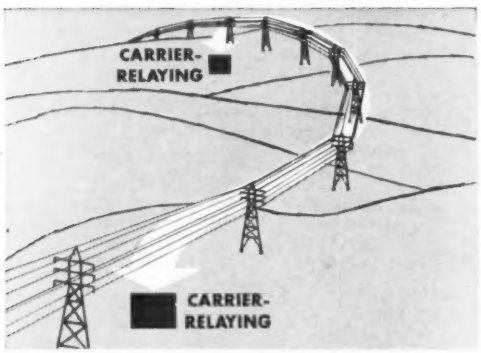
Maintenance and Repair p 179

NEW G-E STATIC RELAY and the carrier complete staged fault test on Muskingum-Philo 138-Kv line of Ohio Power Co. Checking new relay are Mr. Arthur Hauspurg, Relay Section Head, American Electric Power Service Corp.; and Mr. R. H. Macpherson, Manager—Relay Engineering for General Electric.



TRANSISTOR CARRIER CURRENT CHANNEL, together with General Electric's new Static Phase-comparison Relay, provides co-ordinated transmission line protection.

W. E. HUNT, MANAGER—Relay Sales, displays module construction of new static phase-comparison relay.

General Electric Opens a New Era in Protective Relaying

. . . with first static phase-comparison relay

The perfection of reliable static components makes possible practically maintenance-free relays . . . desired by utility men for years. In addition, improved forms of relays using static components will open new fields of application never economically possible before. Static protective relays can now be created that will provide the functions and the characteristics required by modern power systems—higher speed, less maintenance, increased sensitivity, lower burdens.

A line of static protective relays is now on the drawing board for protection of the complete electric utility system . . . transmission lines, transformers, generators and buses.

STATIC PHASE-COMPARISON RELAY is the first in the General Electric line of new static relays. It compares the phase position of currents at the line terminals to provide simultaneous, high-speed tripping of a faulted transmission line. Transistor measuring elements provide higher speed, improved stability of characteristics, and reduction in maintenance costs.

G-E TRANSISTOR CARRIER CURRENT EQUIPMENT provides the communication tie for co-ordinated line protection. Fully transistorized transmitters and receivers offer high-speed channels . . . conservation of frequency spectrum . . . and full 10-watt power output.

This joint product development helps assure electric utilities of improved system protection now . . . and economical system expansion when load growth demands it. 301-406

MORE POWER TO AMERICA

GENERAL ELECTRIC

Electrical World

Vol. 151, No. 26 JUNE 29, 1959

Published for 85 years for those engaged in the business of generating, transmitting, distributing, or applying electric power

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A-Power Holds Center Stage at APPA Meet

Plans hold promise for low-cost nuclear power for small public systems, Seattle convention is told.....p 92

GENERATION

Turbine 'Building Blocks' to Meet Needs

H. R. Reese, Westinghouse Electric Corp

Modular design gives high reliability and low heat rate for wide range of unit sizes, also speeds manufacture.....p 96

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Logic Static Switching for Industrial Control

F. K. Fox, General Electric; R. A. Wise, Bechtel Corp

Logic static switching is binary system, operating in discrete steps, to protect against outage.....p 98

TRANSMISSION

Unusual Foundations for 138 Kv Line

Transmission line for Taconite plant requires specially designed foundations for steel towers.....p 94

Special Report

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Electric Utility Methods

Tailored to present solutions to specific problems are 28 articles in a special quarterly 72-page report for utility men in construction, operation, maintenance, safety, and stores and shops.

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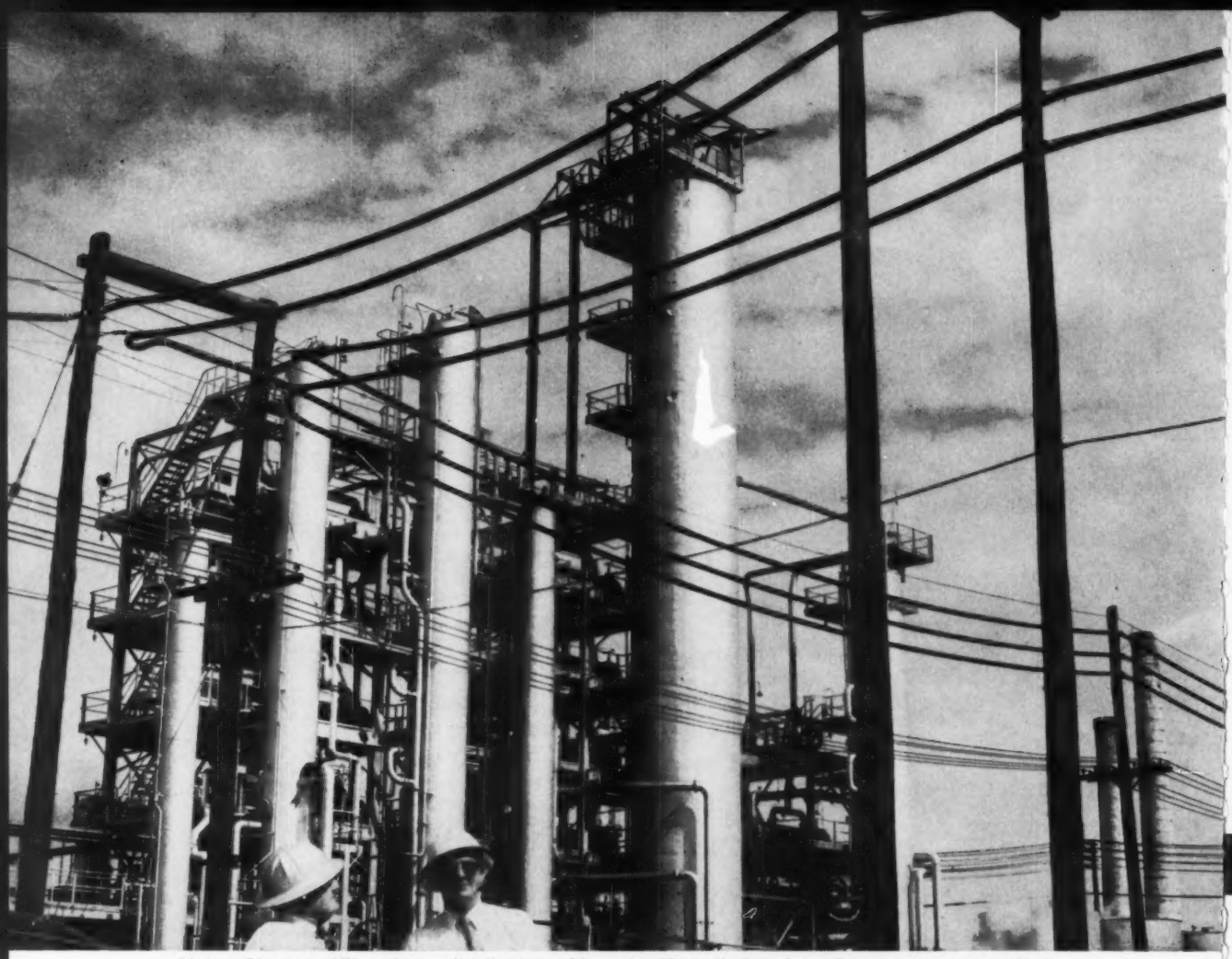

Okonex-Okoprene 15kv primary distribution cables solve Magnolia Petroleum Company's space problem and climate problem (wet and salty atmosphere) and provide greater safety in its Beaumont refinery.

Magnolia Refinery improves voltage regulation, beats humidity with Okonex-Okoprene cables

The giant 1,500-acre Magnolia Petroleum Company refinery, located on the broad Gulf Coast Plain, generates and uses 900,000 kilowatt hours a day, more than its neighboring city of Beaumont, Texas. A cable breakdown here could cause costly damage to equipment and the material in process (more than 400 oil products are manufactured). The entire cable system must serve Magnolia's round-the-clock operation without interruption in the face of the high moisture-saline content of the air, plus the chemicals and intense heat used at many of the processing units.

For the 15kv primary aerial loop distribution system, Magnolia's engineers selected shielded Okonex-Okoprene cables. These butyl-base insulated, neoprene-sheathed constructions saved space, eliminated safety problems and provided improved voltage regulation far superior to previous open wire constructions and other insulated cable constructions studied. In addition, their excellent moisture, heat and corrosion resistance were important assurances of maximum service life.

Okonex-Okoprene, in 3,000 to 15,000 volt constructions, was also used for trunk feeders to and from substations, tie lines and motor leads installed both aerially and underground.

To help you specify the optimum cable for your important power and control cable needs, contact your Okonite representative or write for the free Bulletin EW-1117, "How to choose insulated cable," to The Okonite Company, Passaic, New Jersey.

where there's electrical power . . . there's **OKONITE CABLE**

6339

In the Industry

Electric Heat Gains

One family in four now expresses a desire to go "all electric" in their homes, in the territory of the Puget Sound Power & Light Co. This fact, along with some other very interesting data, was collected in a recent survey by the company.

The survey report contains some other items of general interest to the industry. In comparison with last year's study the following changes are reported: "A year ago, oil was preferred over electricity for home heating by a 4 to 3 margin. Today, electric power is preferred by a 4 to 3 count. In 1958, electric house heating was thought to be better than gas heating for the home by a 2 to 1 margin. Today, the dominance of electric preference has risen to a 3 to 1 count. Electricity was thought by a 3 to 1 margin to be better for cooking and heating water in 1958. Today the margin for use of electric power for these purposes over gas has risen to 10 to 1."

We not only think that these are significant facts. We also believe that more companies should begin to collect this type of statistics for their own territories. It should provide an excellent guide for future promotion.

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ABP **ELECTRICAL WORLD**

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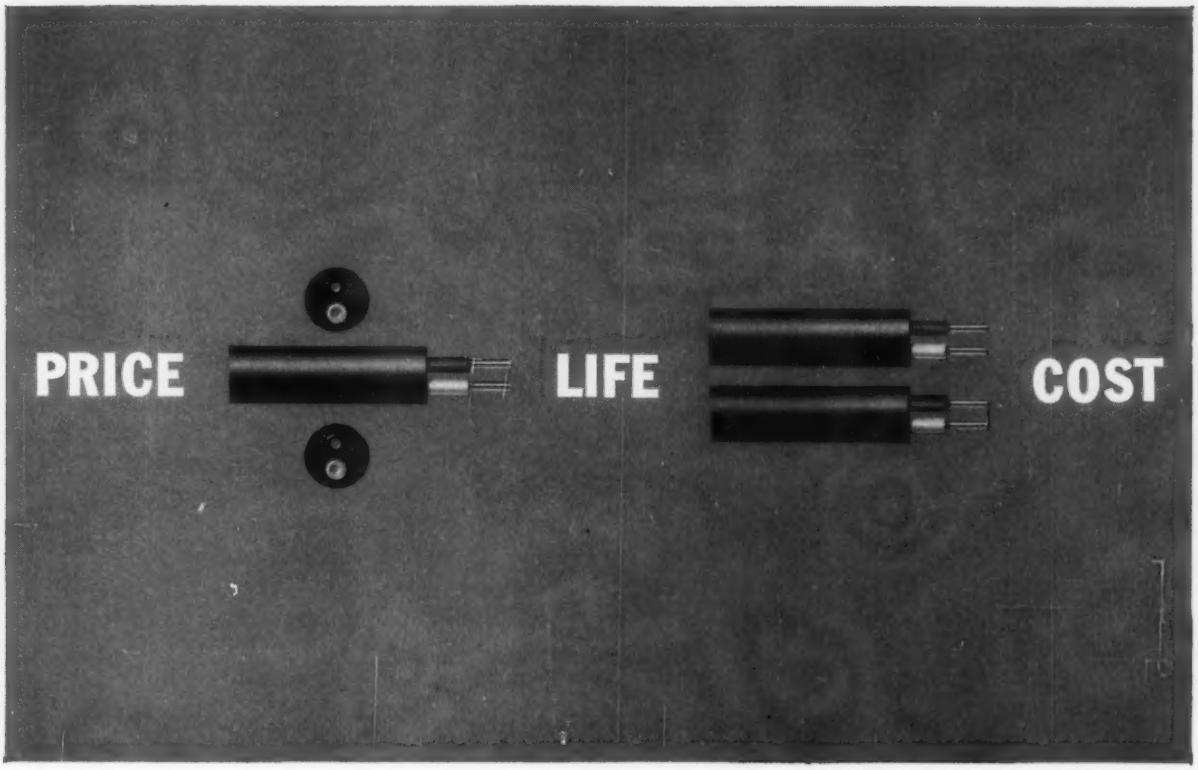

Tirex ...A Case of Symbol Arithmetic

True economy cannot be measured by initial price alone. In buying cords and cables, for instance, the products with lowest prices could well be very expensive in the long run.

Your proper index of value is consistently excellent performance over a long period of time, regardless of the most severe operating conditions.

On this basis, your logical choice is SIMPLEX TIREX. Tirex neoprene-armored cords and cables are made by the original Simplex "cured-in-lead" process. Tough, flexible, and long-lived, Tirex gives you genuine economy by giving you complete dependability.

Write for your copy of the Simplex Tirex cord or cable catalog, which contains complete information, including specifications and application data.

"Built like the finest, toughest automobile tires"

Simplex

LIVE BETTER ELECTRICALLY

WIRE & CABLE COMPANY

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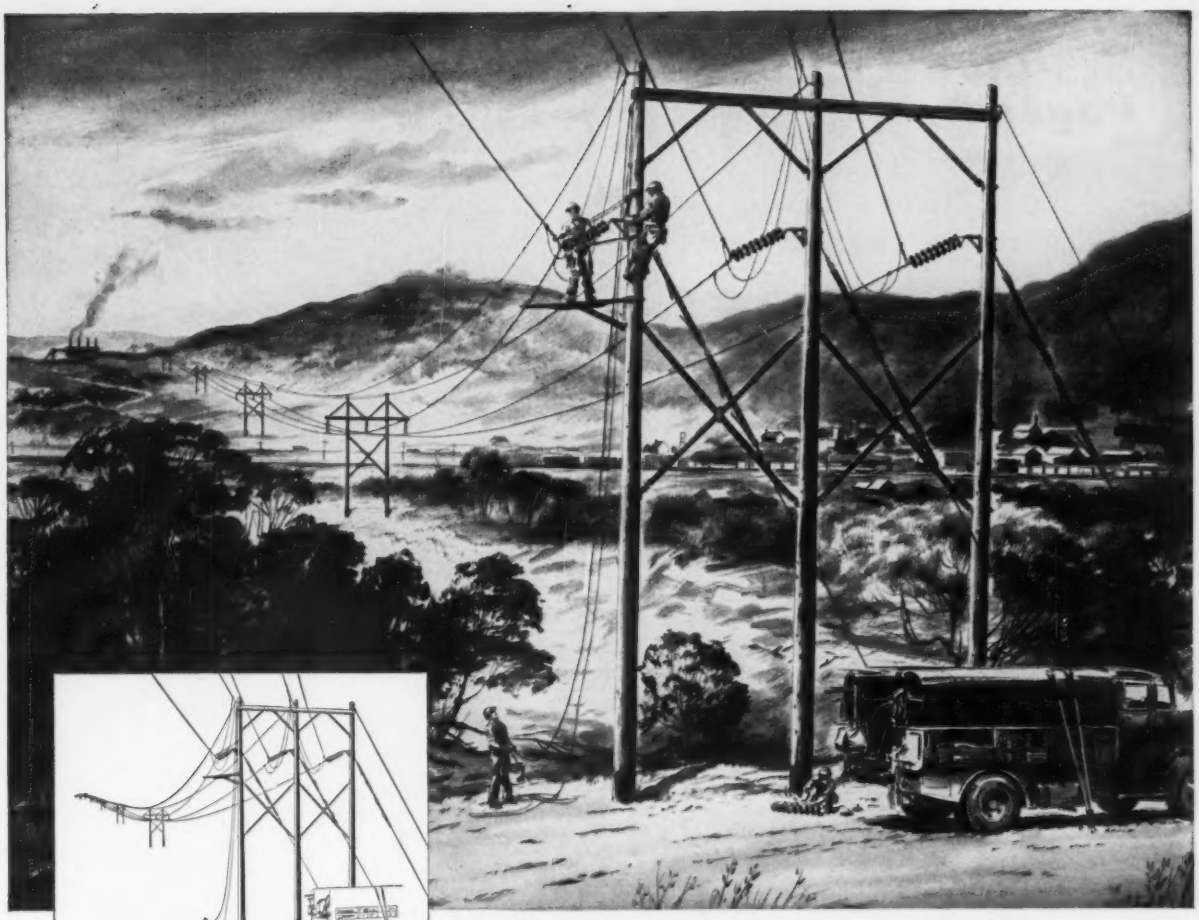

You can get prompt help with any outside construction problem through your Graybar office. In over 130 cities there are Graybar offices and warehouses ready to fill your every need for line materials, hardware and tools. And through any of these offices you can get the help of Graybar Outside Construction Specialists, strategically located in 19 principal cities, equipped by training and experience to give you prompt, dependable help.

Rough terrain—exacting specifications?

Call on Graybar for everything you need

Line building can challenge the skill and ingenuity of the best transmission engineers. When the line runs through rugged country, when the specifications are precise, take full advantage of the broad facilities and specialized experience of Graybar. No matter where your job site may be located, no matter what new requirements may be presented in tensions, insulation and erection, call on Graybar for engineering assistance as well as all your transmission line materials and supplies. If you would like to see our bulletin on High Voltage Transmission Line Materials, and you are located in the U. S. or its possessions, write us for your copy. It's complete with illustrations, applications and specifications. It is free, of course. 710

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GRAYBAR ELECTRIC COMPANY, INC., 420 LEXINGTON AVENUE, NEW YORK 17, NEW YORK, IN OVER 130 PRINCIPAL CITIES

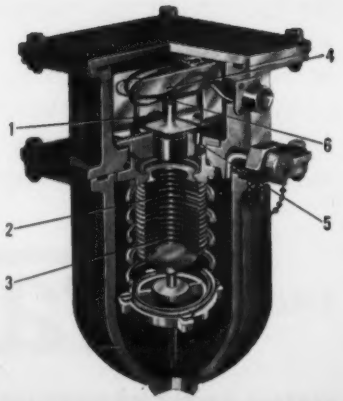
Progress that Pays Off

NEW GENERAL ELECTRIC TYPE J FAULT PRESSURE RELAY GIVES . . .

HERE'S HOW IT WORKS

The Type J-Relay responds to the oil shock wave or rapid rise of oil pressure produced by an internal fault. The shock is transmitted to the piston (1) via the bellows (2) and silicone oil (3) in the lower chamber. The piston operates the switch (4) signalling the circuit breakers to open.

Two features help prevent false tripping. Equalizing holes (5) permit passage of silicone oil when transformer operating pressure varies. The J-device is thereby equally fault-sensitive regardless of operating pressure level. Also, special gap (6) between piston and switch guards against relay operation due to system surges and through faults.



Fast, Effective Fault Protection for Power Transformers

HELPS PREVENT EXCESSIVE DAMAGE AND REPAIR COSTS, MINIMIZES SYSTEM DISTURBANCES IF A TRANSFORMER FAULT OCCURS

Power transformers seldom fail today. However, if an internal fault does develop, system disruptions and transformer damage (and thus repair costs) can be minimized by rapidly de-energizing the unit. The new General Electric Type J Fault Pressure Relay is designed to trip circuit breakers by quickly responding to the abnormal rise in oil pressure produced by a fault. The relay is recommended for all power transformers to supplement differential relays.

ADVANTAGES OF THE NEW J-RELAY ARE:

Rapid Fault Sensitivity because the relay responds to the full pressure wave transmitted by oil. Operation will occur whenever the rate-of-rise exceeds 0.5 psi/sec. For major faults, operation will occur in less than one cycle.

Constant Accuracy at all transformer operating pressures. A pressure equalizing or differential feature permits the relay to compensate for normal pressure variations which could otherwise bias its operation.

Guards Against False Tripping which could result from system surges, through-faults, mechanical shocks and vibration. Special design features and the mounting position in oil, where the relay responds to the primary fault pulse, help prevent false operation.

Full Accessibility for inspection or testing as desired. The relay is located on the tank wall near ground level and can be removed, if ever necessary, without de-energizing the transformer.

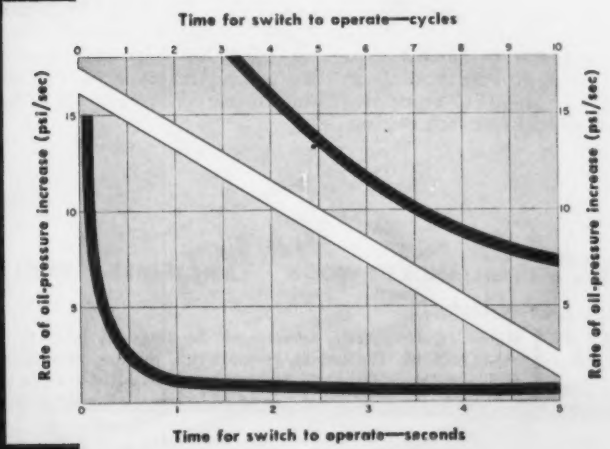
Economical, Effective Protective System results from joint use with gas-detector relay which warns of incipient faults.

The price of this relay on your next G-E power transformer is $350—a small price when compared with possible repair-cost savings alone. For further information, contact your General Electric Apparatus Sales Engineer or write for bulletin GEA-6916 to General Electric Co., Section 421-58, Schenectady 5, N. Y.

Progress Is Our Most Important Product

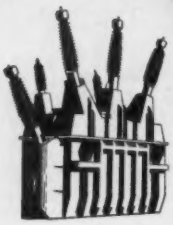
GENERAL ELECTRIC

RAPID OPERATION—Time vs oil pressure (rate-of-rise response) curve illustrates quick relay operation. Pressure increases shown are those in primary medium—transformer oil—where shock wave is greatest.


Time for switch to operate—cycles
0 1 2 3 4 5 6 7 8 9 10
Rate of oil-pressure increase (psi/sec)
15
10
5
0 1 2 3 4 5
Time for switch to operate—seconds

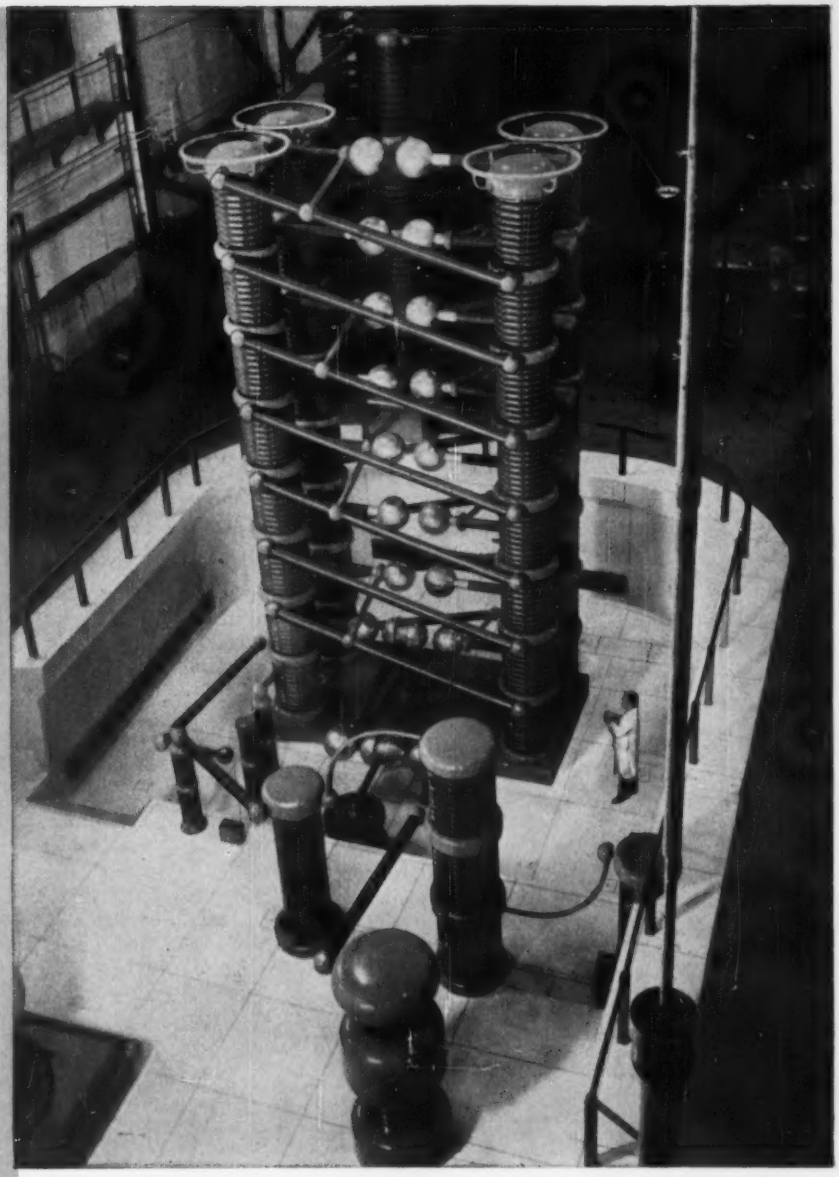
UNIVERSAL APPLICATION—Operating in oil, the new G-E Type J relay can be used on all power transformers, regardless of oil preservation method, including those with the superior Atmoseal* system.

* Trade-mark of General Electric Company.



Transformer Capacity of over 5,000,000 kVA per annum

The Ferranti transformer plant at Hollinwood, Lancashire, England, covering an area of over 300,000 sq. ft., has a manufacturing capacity per annum of over 5,000,000 kVA of Large Power Transformers, Distribution Transformers, Voltage Regulators, High Voltage A.C., D.C., and Impulse Testing Plant and Specialised Equipment. Contracts include the supply of transformers for the Garrison Dam and McNary Dam Projects in the U.S.A. and the Alcan Project in Canada.



National Physical Laboratory

This Ferranti Impulse Generator at the National Physical Laboratory, Teddington, England, by whose permission the photograph is reproduced, generates 3,200,000 volts and has an energy rating of 77 kW seconds. This is a typical example of the type of A.C. and D.C. equipment manufactured by Ferranti Ltd., for routine and research testing.

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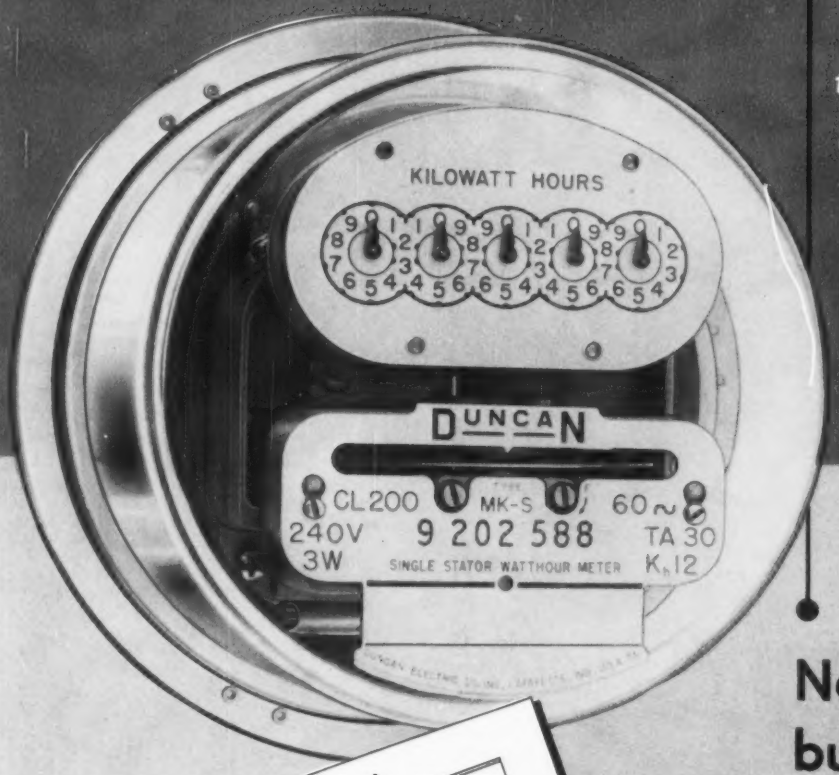
Class 200 Ratings *for More Housepower!*

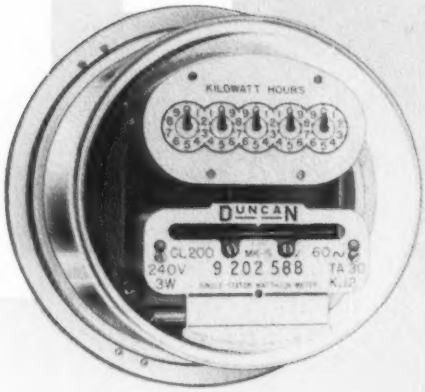


Now your dollar buys more Metering Capacity!

DUNCAN

Concentrates on Metering Equipment—the attention of the entire Duncan Organization is devoted to your metering requirements.

"Thinking Ahead . . . Moving Ahead . . . to stay Ahead of Demand!"



TYPE MK— SINGLE PHASE METERS

are available in three classes: 10, 100, and 200

The class of each represents the maximum current for each rating, i.e., 10 amps., 100 amps., and 200 amps. They represent the latest carefully engineered product in a long line of Duncan developments and are built to accurately meter a wide range of loads from a few watts to a full 200 ampere. The damping magnet system is composed of two high energy Alnico magnets positioned above and below the disc, which provide calibration stability and substantial freedom from tilt error. Arc-resistant insulation and self-contained arc gaps to by-pass electrical disturbances protect the MK from insulation failures.

Simplification of design provides for a minimum number of parts —improving reliability—reducing necessity for repairs—but making any maintenance convenient. A three position cover ring, separate worm wheel with mesh independent of the register, and adjustments operated from the front, make this "Meterman's Meter" convenient to calibrate and maintain.

MEET INCREASING LOADS

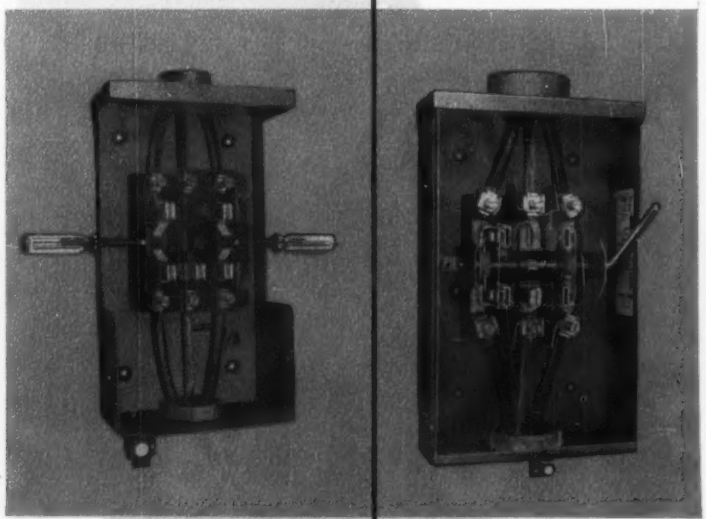
With Extended Range Single phase meters and Mounting Devices with 200 Amp. Capacity

HQ-5 *(Below)*

For Commercial or "High load factor loads" up to 200 Amp. capacity

MD-5

For residential or "low load factor loads" up to 200 Amp. capacity



LIVE BETTER ELECTRICALLY WITH FULL HOUSEPOWER

DUNCAN ELECTRIC CO., INC.

Lafayette, Indiana.

The Electrical Week

LATE NEWS ▸ **Senate Public Works Committee produces a "new" TVA-bond bill,** new in that numerous amendments have been added, even though it retains the number of the House-passed measure—HR 3460.

Rates and Regulation . . . Jersey Central P&L and New Jersey P&L put in 1.8¢ electric heating rate . . . Houston, Texas, City Council grants average 12¢-per-month residential rate hike to Houston Lighting & Power. HL&P asked for 18¢ . . . Decatur, Indiana, City Council adopts resolution accepting Indiana & Michigan Electric Co's $2,099,100 offer for the city-owned plant and franchise . . . Campbell, Ohio, City Council grants 6½% rate hike to Ohio Edison Co.

Line Material announces electronically controlled transformer which is self-regulating. L-M reports field tests have been gratifying.

TVA grants 4.6% salary increase to some 5,800 white-collar workers. The boost spells an increased payroll cost of $1,736,000 a year.

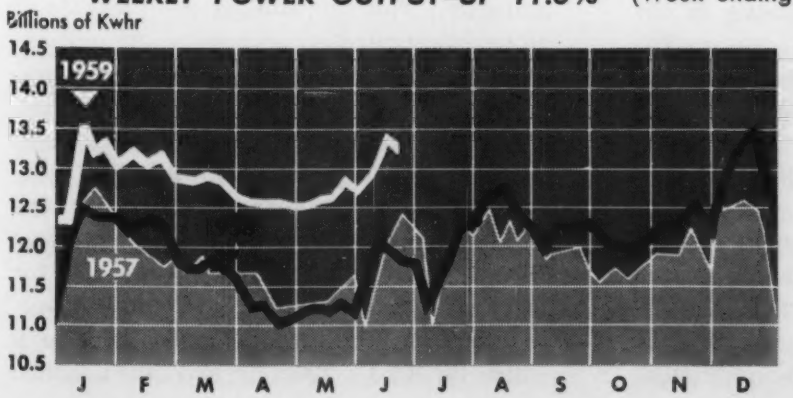
Clifty Creek Plant is world's most efficient generating station, according to announcement by Ohio Valley Electric Corp. Plant's heat rate of 9,130 Btu/kwhr is the lowest of any plant during 1958.

American & Foreign Power is going ahead with expansion plans in Latin America, despite local political uncertainties.

Ontario Hydro to get $60-million A-plant, at a site to be determined. Atomic Energy of Canada, Ltd will design and build it.

Management changes . . . Tampa Electric elects J. D. Hicks vp-operations . . . J. F. Jones becomes vp of Burndy Corp . . . Josyln Mfg & Supply elects G. B. Brown vp . . . Haywood Publg Co appoints P. B. (Jack) Garrett as publisher & editor of Electric Light & Power.

WEEKLY POWER OUTPUT—UP 11.6% (Week ending June 20), Kwhr 13,331,000,000



Per Cent Change From Previous Year

	June 6	June 13	June 20
Total U. S.	+11.5	+11.5	+11.6
New Eng.	+11.3	+11.4	+10.8
Mid Atlantic	+15.1	+16.0	+ 9.8
Cent. Ind.	+17.5	+17.9	+16.7
West Cent.	+ 8.3	+11.3	+15.2
Southeast	+ 6.1	+ 3.7	+ 5.3
South Cent.	+ 1.1	+ 1.2	+ 7.7
Rocky Mount	+ 6.5	+10.0	+14.5
Pacific			
NW	+18.7	+18.7	+18.5
SW	+14.9	+15.3	+14.2

Seasonally Adjusted Index 250.3

Week ago 258.6 Year Ago 225.0

Source: Edison Electric Institute

Preview of this Issue

EVENTS ▶ **Plans for a new 50-Mw A-plant were revealed by Consumers Power Co** last fortnight. The boiling water reactor will cost $30 million and be completed in '62. GE and Bechtel Corp will build it (**p 87**) . . . Strike ends as 5,400 Public Service of New Jersey workers settle for 5.34% increase after 39-day walkout (**p 86**) . . . Warren Shew, Electrical World advertising sales manager, has been named publisher, and Charles Hochgesang, assistant to the editor, has become editor. Fischer Black, editor and publisher, has been appointed administrative vice president, Tampa Electric Co (**p 89**).

SPECIAL REPORT ELECTRIC UTILITY METHODS ▶ **Answers to 28 problems in construction, maintenance, and operation,** plus safety, stores and shops, comprise 1959's second special report on Electric Utility Methods. Highlights in its 72 pages:

- **Four 115-kv circuits are "shoehorned" into 80-ft R/W** by construction crews at Connecticut Light & Power (**p 149**).
- **Better ground controls give accurate results** in aerial survey of coal supplies by Ohio Edison (**p 152**).
- **Truth gages aid waterwheel repairs** at West Penn Power (**p 156**).
- **New Equipment this week is in the EUM report (p 129).**

ENGINEERING ▶ **Putting up transmission towers can become a problem** if they have to

Politics and Public Power

ADVICE THAT WILL GO UNHEEDED

The Comptroller General of the United States is stubbornly insisting that the rural electric co-ops have grown up . . . and no longer need to be propped up with sub-market interest rates. But at the same time, no one knows better than he that Congress will probably ignore his advice.

Joseph Campbell, in his capacity as the Congressional watchdog of the Treasury, has made his annual audit of the Rural Electrification Administration.

In his report on fiscal year 1958, he notes that less than half the nation's farms were receiving central station service in 1944 when the flat 2% rate for REA loans was written into law. Now, fully 95% of the farms are electrified. Reflecting the co-ops' continued growth and financial stability, their operating revenues are up 44% in four years, and operating margins increased from 8.5 to 13.2% in the same period.

REA approved loans to only three new electric borrowers in fiscal 1957 and 1958—fully 98% of loans in this period went to previous borrowers.

All this, in Campbell's view, adds up to maturity. Yet the subsidy in fiscal 1959 alone is expected to amount to $2 million. That is the difference between the interest the Treasury must pay to get the $370 million to loan co-ops, and the amount of interest they will pay on their loans this fiscal year.

The Comptroller General recognizes that legislative proposals are outside his bailiwick. But he wryly notes that a law "providing for increased interest rates" would stop this burden on the Treasury. He also has sharp words for REA actions on two other counts:

be built on Muskeg, a mixture of mud and decayed vegetation. Read about the special provisions needed to put 58 towers across boggy terrain in Minnesota (p 94) . . . Large turbine elements will help meet future power needs better (p 96) . . . Co-op uses dry-type transformer as an auxiliary unit, simplifies steam station structure (p 110).

PROCUREMENT & PRODUCTS ▶ **Cleveland Dept of L&P saves $40,000 a year on fly ash disposal** . . . Street lighting equipment prices cut 5-15% by Westinghouse . . . Coal company executive predicts rise in gas and coal prices (p 114).

MANUFACTURERS ▶ **General Electric unveils automated machine tools** for doing everything from drilling holes to shaping steam turbine buckets . . . Appalachian Electric's Clinch River No. 2—with current efficiency rate of 9.100 Btu/kwhr—takes 14 miles of "Kaylo" insulation (p 118).

MANAGEMENT ▶ **West Penn Power has a new approach to management development.** The company's four-week school for managers combines the advantages of professional instruction and in-company group training. Read how West Penn helps qualify its men for the next step up (p 205).

SELLING ▶ **Utility exec says, "It's time for electric heating to grow up!"** (p 209).

• In some instances, REA has advanced funds for payment of interest anywhere from 75 days to a year before the interest is due—thus constituting an unnecessary cost to the Treasury, which must pay more than 2% for the funds advanced. The administration has promised to take action "so that advances of funds for interest will not be made too far in advance of need by the borrowers."

• REA approved a $11.5-million loan to Medina Electric Cooperative of Hondo, Tex., some $675,000 of which is to be advanced by Medina to a gas company for provision of pipeline facilities to deliver fuel to the co-op's generating plant. Campbell complains that Medina will receive 5% from the gas company on funds for which it pays REA only 2%. The co-op answers that the interest rate is immaterial, because the fuel cost to the co-op would be adjusted accordingly anyway.

Nonetheless, Campbell recommends that the REA Administrator, "prior to approving similar loan terms in other loans, re-examine the criteria . . . relating to advance of loan funds to third parties."

Opinions of the Comptroller General carry great weight, and often result in corrective action. However, Campbell has no power to enforce his opinions or decisions, particularly if Congress happens to disagree with him. This was dramatically illustrated in the Central Iowa Power Cooperative case (EW, Aug. 11, 1958, p 35) covered in his current report. Repeating his belief that the law does not intend loans to compete with existing service, he recognizes that Congress has acquiesced in REA's making such loans.

By the same token the 2% rate can be changed only by Congress, and Campbell recognizes also that this will not happen without a drastic change in its complexion.

Executive Reader

Growth trends indicate that U.S. utilities will need $54 billion to finance construction between now and 1970. Only 40% will be generated internally, but there should be no trouble raising the remainder, assuming 10 years of great economic growth, a free-enterprise economy, and "peace" in the world. **G. M. Ives, Morgan Guaranty Trust Co of New York, Pacific Coast Electrical Association Annual Convention, San Francisco, May 22, 1959.**

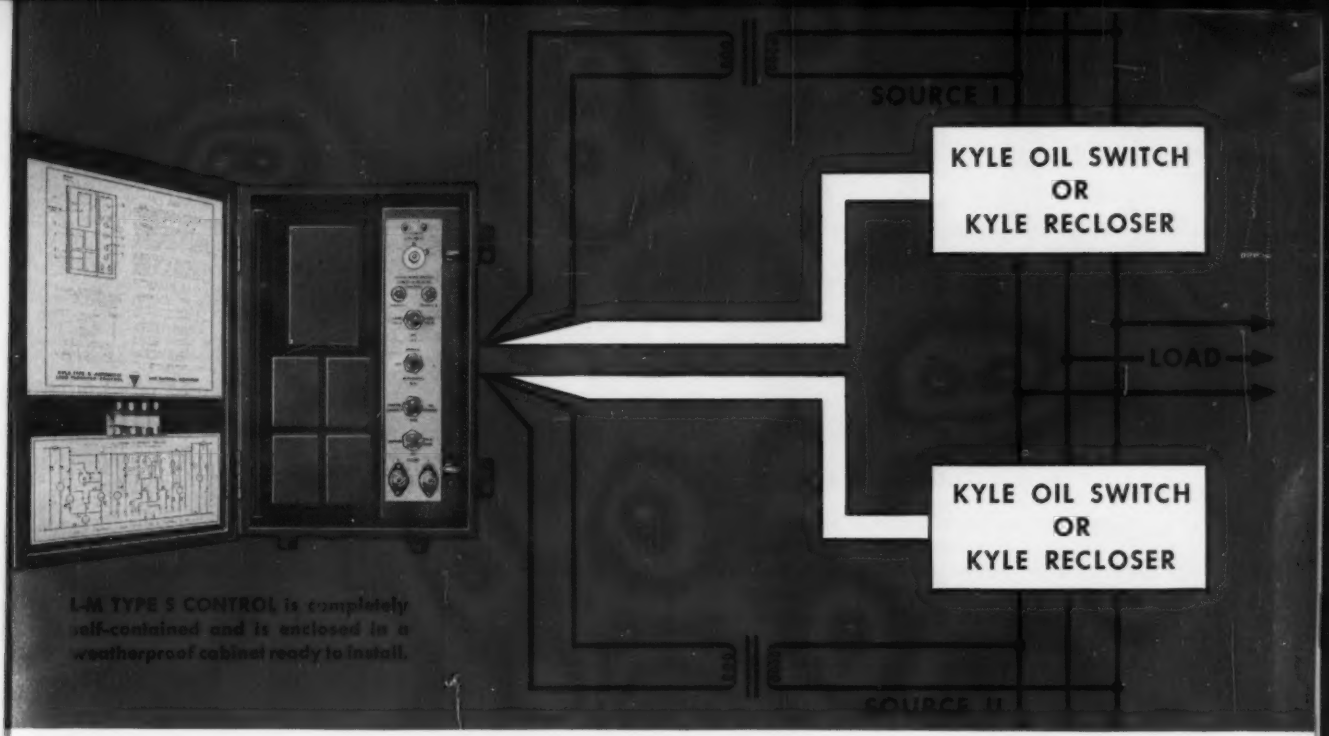
As inflation increases, the utilities, unable to raise their rates as do unregulated businesses, may face extinction pending action by dilatory regulatory commissions. This terminal condition may be forewarned by an inability to attract capital. **Public Utilities Fortnightly, June 4, 1959.**

Flame resistance of a polymer plastic is proportional to the number of chlorine atoms that can be packed with stability into the basic monomer. Such a highly-chlorinated monomer has been synthesized, from which is made polytrichloropropene, a polymer that will not support combustion. If the monomer can be co-polymerized with butadiene, then a flame-resistant rubber will be available for electric wire coatings. **Research for Industry, Vol 11, No. 3, May 1959, Stanford Research Institute.**

Switchgear basically has no overload capacity. However, proper coordination of substation design can utilize full transformer emergency loading capability. Often it's more economical with larger stations to plan expansion toward greater total lower-current breakers. **J. A. Smith, General Electric Co, Rocky Mountain Electric League Spring Conference, Denver, April 20, 1959.**

Electric companies must be on the alert continually—making certain that good customer relations are being maintained, while seeking new ways to improve these relations. If adequate means of measuring customer opinion are not provided, even established and popular policies and practices can slowly cause customer dissatisfaction without the utility being aware of it until it is widespread. **E. O. George, Detroit Edison Co, EEI Bulletin, May 1959.**

Bartering of fuel for electric power and steam through cooperative agreement with an electric utility offers a good opportunity to an oil refinery anxious to obtain the ultimate in improved thermal efficiency. Such an exchange of refinery fuel for power and steam should be considered in many cases, even without an immediate saving in refinery operating cost. **E. J. Hess, Esso Standard Oil Co, Petroleum Week, June 5, 1959.**



Kyle Type S Load Transfer Controls Give Economical Service Continuity

L-M new Type S control provides automatic load transfer for installation where a continuous power supply is a must.

The new Kyle Type S Automatic Load Transfer Control is a self-contained system, working with oil switches or reclosers to provide maximum service continuity with a minimum of investment. It provides a primary radial system with reliability approaching that of a network system at only a fraction of the cost. It is most economical compared to any other load transfer system.

The Type S is a preassembled, prewired packaged control, in a weatherproof cabinet. It is suitable for installation at hospitals, shopping centers, industrial plants—wherever continuity is important.

Designed for use with Kyle Type NR and VR oil switches or Type R and W reclosers, it provides a wide degree of variation in the selection of the power feeder. Since the control and the switches or reclosers are separate from each other, power can be supplied to the load by operating either switch or recloser manually, while the system is being installed or maintained—no need for service interruption. Switches and reclosers have self-contained operating mechanisms.

This control, by sensing the voltage on one phase of each source, actuates the motors or solenoid operators of the oil switches or reclosers, and connects the distribution feeder to the desired source.

Time-delay relays are adjustable through a wide range to insure coordination with backup protective devices and to prevent oil switches from opening when a fault occurs.

Contact your L-M Field Engineer or write Line Material Industries, Milwaukee 1, Wisconsin. In Canada: Canadian Line Materials, Ltd., Toronto 13, Ontario.

Choice of Operating Sequences Illustrating the Versatility of Type S Control

1. Transfer to the alternate source, after a time delay, when the preferred source is de-energized and voltage is present on the alternate source.
2. Transfer back to the preferred source automatically, after a time delay, when normal voltage is restored to the preferred source.
3. Elimination of the second outage by paralleling sources when returning the load to the preferred source.
4. Holding load on the alternate source after normal transfer from the preferred source. (Manual operation is required to transfer load back to the preferred source.)
5. Manual transfer.
6. No-preference operation for use when either source is considered desirable for continuous load supply.

NEW L-M TYPE S CONTROL. Automatic load transfer switch provides continuity of service . . . with minimum of dollar investment.

LINE MATERIAL® Industries
McGRAW-EDISON COMPANY
Kyle® Switchgear

McGRAW-EDISON

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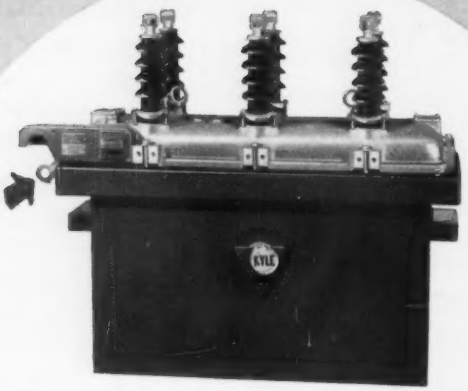
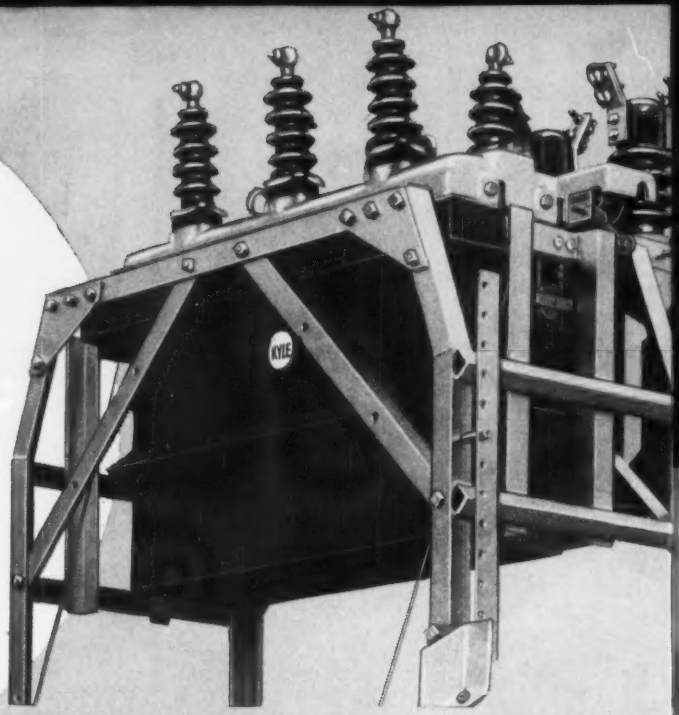
DISTRIBUTION TRANSFORMERS • KYLE RECLOSERS AND OIL SWITCHES • FUSE CUTOUTS AND FUSE LINKS • LIGHTNING ARRESTERS • POWER SWITCHING EQUIPMENT
PACKAGED SUBSTATIONS • CAPACITORS • REGULATORS • OUTDOOR LIGHTING • LINE CONSTRUCTION MATERIALS • PORCELAIN INSULATORS • FIBRE PIPE AND CONDUIT



KYLE TYPE R heavy-duty 3-phase recloser. Available in 12 current ratings from 25 to 400 amperes, 2.4 to 14.4 kv. Interrupting ratings up to 6,000 amperes at 4.8 kv. Note that the trip-free operating lever functions both for manual opening and manual closing. Further, this lever is a lockout position indicator when in the down position.



KYLE TYPE W heavy-duty 3-phase recloser is rated from 100 to 560 amperes, 2.4 to 14.4 kv; interrupts up to 12,000 amperes at 4.8 kv, 8,000 at 14.4. Can be unbolted from mounting frame easily with common wrenches; no wrench extensions or unusual tools required.

Kyle Types R and W Heavy-Duty Reclosers Offer Unmatched Features and Operation

Dial your operating sequence! Finger-tip, positive, pretested indexed positions for: (1) timing; (2) operating sequence; (3) number of operations to lockout.

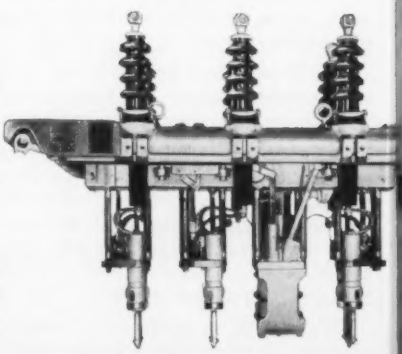
With more extensive recloser engineering and field experience than any other manufacturer, Kyle has produced in the heavy-duty Types R and W reclosers, apparatus that is completely unmatched by any similar products now available.

Kyle reclosers offer many advantages in operation that make coordination easier and more exact; reduce burndowns; and thus improve service continuity.

The Kyle operating mechanism is readily accessible. Contacts are visible and may be inspected when open. Coils may be changed in the field. The number of fast curves may be selected and changed simply by turning a dial. Two retarded curves are precalibrated at the factory, so no "cut and try" adjustments involving expensive testing time are needed if the user desires to change from one retarded curve to the other. Every Kyle Type R and W is completely and accurately factory precalibrated on all of its time-current characteristics, not just the single characteristic specified on the order. Actually, every R and W has over a hundred factory timing-test operations.

Let Us Supply Bulletins

These are some of the many superior design and operating features that make the Kyle Types R and W the best reclosers on the market. Ask the L-M Field Engineer for complete information. A large library of literature is available—on application, operation, and maintenance. He will be glad to supply whatever you can use. Or write Line Material Industries, Milwaukee 1, Wisconsin. In Canada: Canadian Line Materials, Ltd., Toronto 13, Ontario.



MECHANISM WITH TANK LOWERED. With the Kyle unit, the recloser frame can raise or lower the entire recloser, or lower the tank only, for inspection or maintenance. Kyle reclosers are completely self-contained; no additional external power source is required to operate them.

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LM® Kyle® Switchgear McGRAW EDISON

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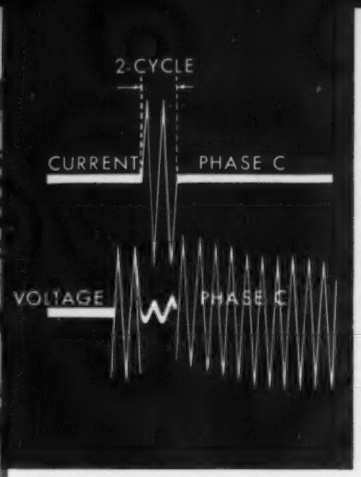
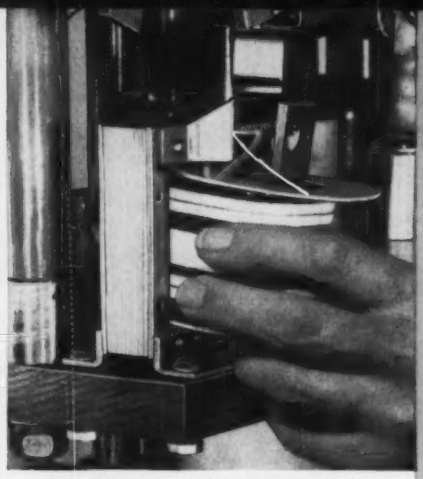
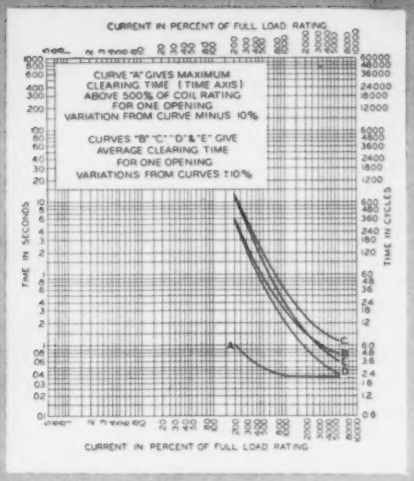


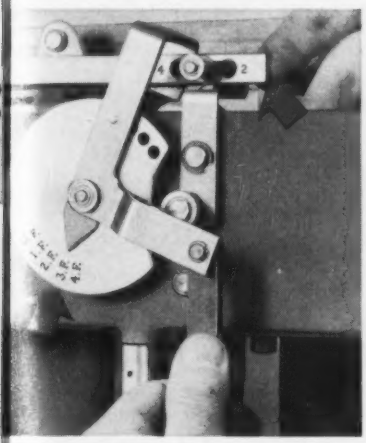
OSCILLOGRAM shows typical example of current interruption. *Maximum* clearing time over most of fault current range for the Type R is 2 cycles; 2½ cycles for the W. This is total, starting at the instant the fault occurs, and includes sensing, operation, and final arc quenching.



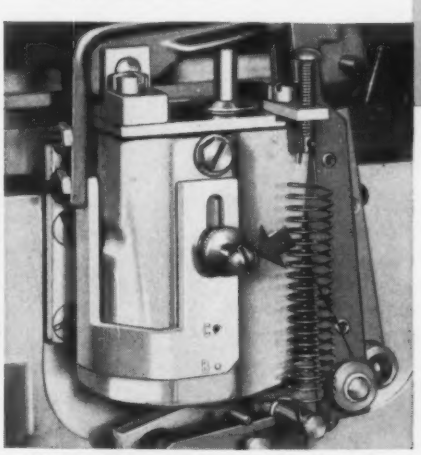
CHANGING THE SERIES TRIP SOLENOID, which determines the tripping current, is easily done in the field. Both reclosers are available in a wide range of tripping currents, affording a wide degree of application and permitting proper feeder protection as the load changes.


CURRENT IN PERCENT OF FULL LOAD RATING
CURVE "A" GIVES MAXIMUM CLEARING TIME (TIME AXIS) ABOVE 500% OF COIL RATING FOR ONE OPENING VARIATION FROM CURVE MINUS 10%
CURVES "B" "C" "D" & "E" GIVE AVERAGE CLEARING TIME FOR ONE OPENING VARIATIONS FROM CURVES ±10%
TIME IN SECONDS
TIME IN CYCLES
CURRENT IN PERCENT OF FULL LOAD RATING

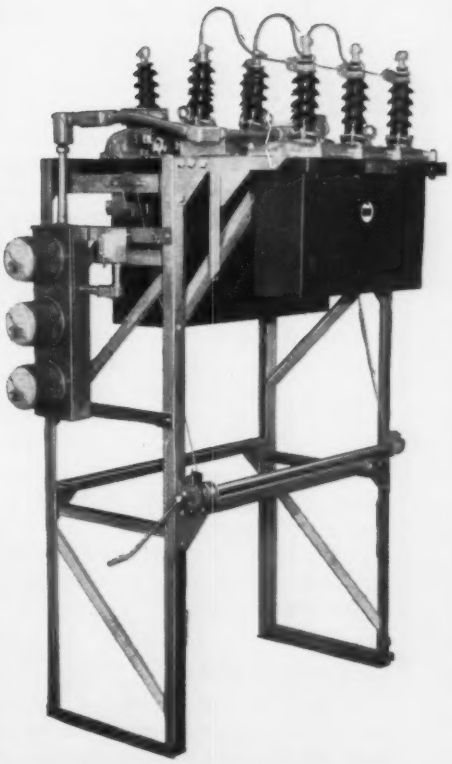
CHOICE OF FIVE CURVES—one fast (instantaneous) and four time-delay curves—is available on phase tripping. Delay curves B and C are obtained with one piston assembly, by simple change shown above. Or, with modification of the piston assembly (not a field operation), the reclosers are available with choice of D or E curves. No "cut and try" adjustment in the field.



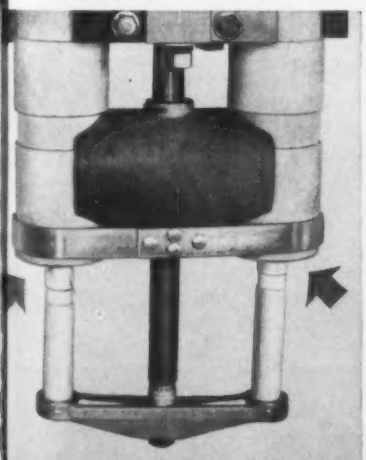
THESE RECLOSERS may be set for 2, 3, or 4 operations to lockout by simply re-indexing the lockout bar. Changing the easily accessible dial permits selection of 0, 1, 2, 3, or 4 fast operations. Any remaining operations to lockout will then be the delayed operations on the B or C curve, whichever is selected.



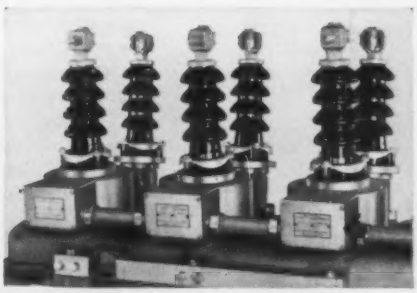
FOR CHOICE OF time-delay curves it is only necessary to loosen this thumb-screw and index the adjustment bracket to the curve desired. Both retarded curves have been test-board-calibrated, and no "cut and try" adjustment is necessary in changing to the other curve.



RIGID SUBSTATION MOUNTING FRAME. Windlass hoists recloser to any desired height without additional equipment. Since entire mechanism is suspended from the head, the recloser frame can raise or lower entire recloser, or lower the tank only, for easy inspection or maintenance.



DOUBLE-BREAK CONTACTS with oil cross-blast arc extinction. In the open position the contact tips are accessible for visual inspection—no disassembling necessary. Contacts cannot fall closed.



BUSHING CURRENT TRANSFORMERS are available as an accessory. These are mounted on the *outside* of the tank, where terminals are accessible by means of a screw plate. No untanking necessary.

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Kyle® Switchgear

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JUNE IS L-M SUBSTATION MONTH!

New L-M Feeder-Pak® Provides Compact, Low-Cost, Low-Voltage-Side Unit

Shipped in pre-wired, assembled sections, ready for fast, economical installation in substation as complete 15 kv feeder unit.

by **W. V. SWAN**, Product Manager
Power Switching Equipment
Line Material Industries

The new L-M Feeder-Pak is a complete unit for the low-voltage side of a substation. It provides support for feeder conductors, disconnect and by-pass switches, lightning arresters, current transformers, and substation-type R or W three-phase Kyle heavy-duty recloser.

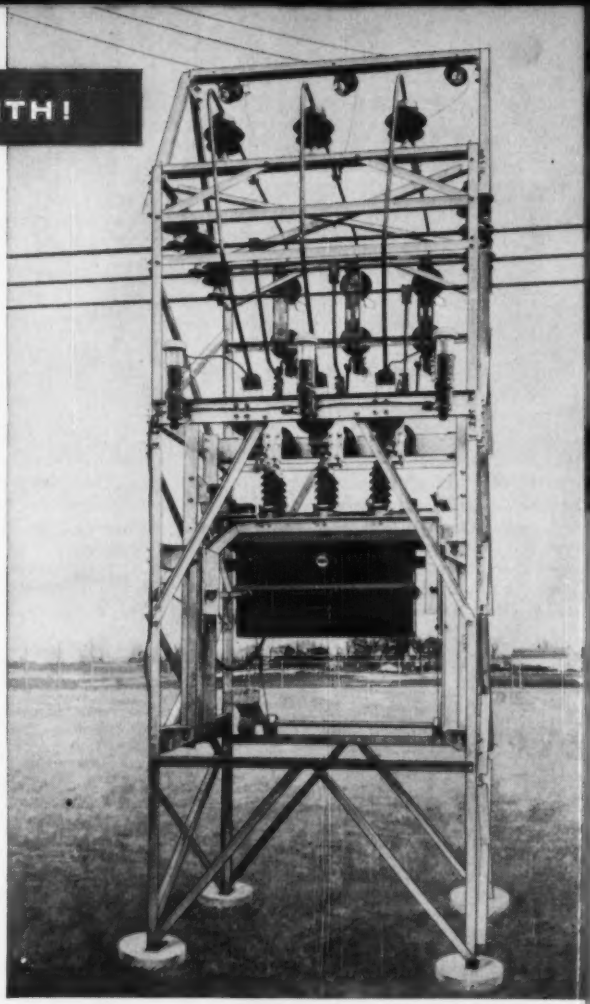
Neat, Compact

The unit has a very neat appearance. It is compact, easy to install. The whole unit comes in easy-to-handle crates. Additional units can easily be added when additional feeders are needed. Or units can be removed to other locations.

The Feeder-Pak costs about the same as the *materials* for a conventional open-type feeder position, but installation costs are far lower. Bus, insulators, switches, and arresters are all in place. No concrete pad is needed—only footings for the four legs. And it takes less land area—it's only 5 feet, 4 inches square!

Easy to Install

To erect the L-M Feeder-Pak, simply bolt the lower section to the concrete footings; set the upper section into the lower section and bolt; raise the recloser into position with the hoisting mechanism included in the lower section. Self-aligning bayonet-type contacts work automatically as recloser is raised into position. Automatic interlock prevents lowering the recloser until recloser contacts are opened.



THE NEW L-M FEEDER-PAK. The lower pre-assembled steel section contains the recloser, and recloser lifting frame and lifting mechanism. The unit is neat, compact. Base is only 5 feet, 4 inches square. It saves land, cuts installation and maintenance time. No mounting pad is required—just footings for the four legs.

L-M Feeder-Pak Features

1. With Kyle Type R or W recloser provides complete structure and equipment for low-voltage side of the substation.

2. Complete; compact; neat. Saves land costs; requires no pad; cuts installation man-hours.

3. Shipped as partly assembled units, crated for easy handling. Switches, arresters, and recloser disconnects are all pre-wired, and installed. Current transformers if desired.

4. Additional feeder positions are easy to add; or the Feeder-Pak may be removed to another location if desired.

5. Recloser lifting frame and tank lifting device make recloser maintenance safe and simple.

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Substations and Power Switching Equipment®

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DISTRIBUTION TRANSFORMERS • KYLE RECLOSERS AND OIL SWITCHES • FUSE CUTOUTS AND FUSE LINKS • LIGHTNING ARRESTERS • POWER SWITCHING EQUIPMENT
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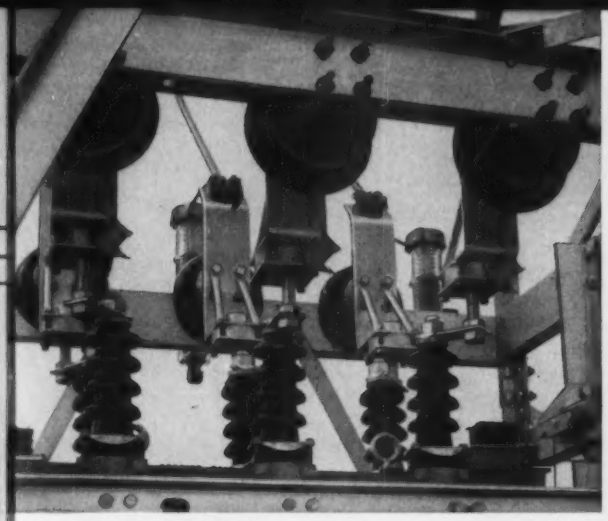
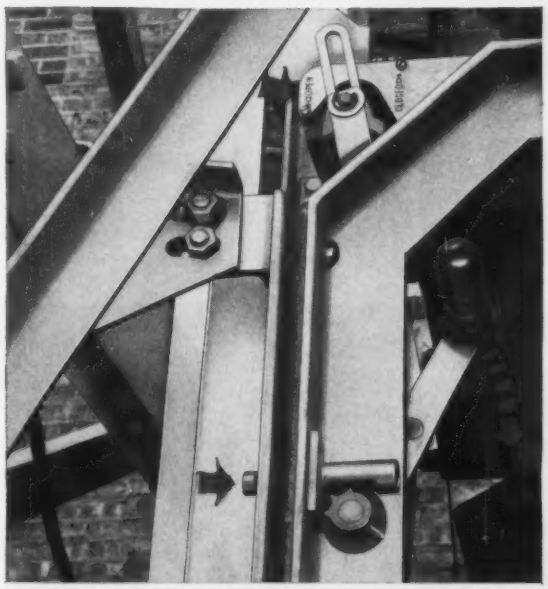
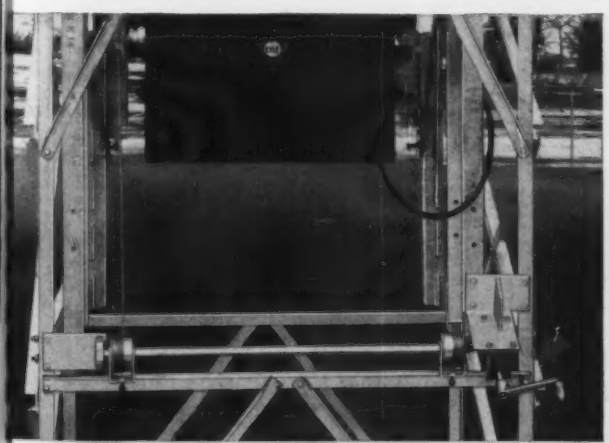


BAYONET CONTACTS on the recloser bushings are raised into the self-aligning automatic disconnects when the recloser is lifted into position. Thus connections are made safely, simply, and automatically.

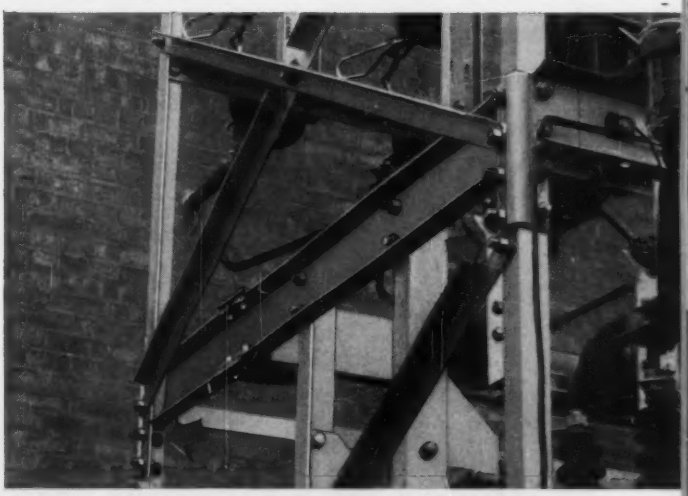


CONTROL LEVER INTERLOCK. Recloser cannot be lowered until recloser contacts have been opened by moving the handle down (arrow).



RECLOSER LIFTING MECHANISM makes it easy to lower the recloser, and, if desired, to lower the tank to inspect the mechanism, change coils or time-current characteristics —which is easily and accurately done on Kyle reclosers— or for periodic oil change.

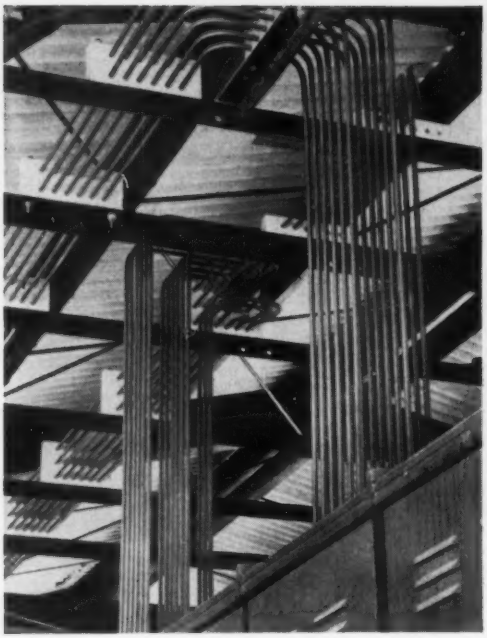
LINEMAN CLOSES BYPASS SWITCHES before lowering the recloser. These are L-M Type HXO heavy-duty fused switches. They are mounted on the frame and connected to the bus at the factory.

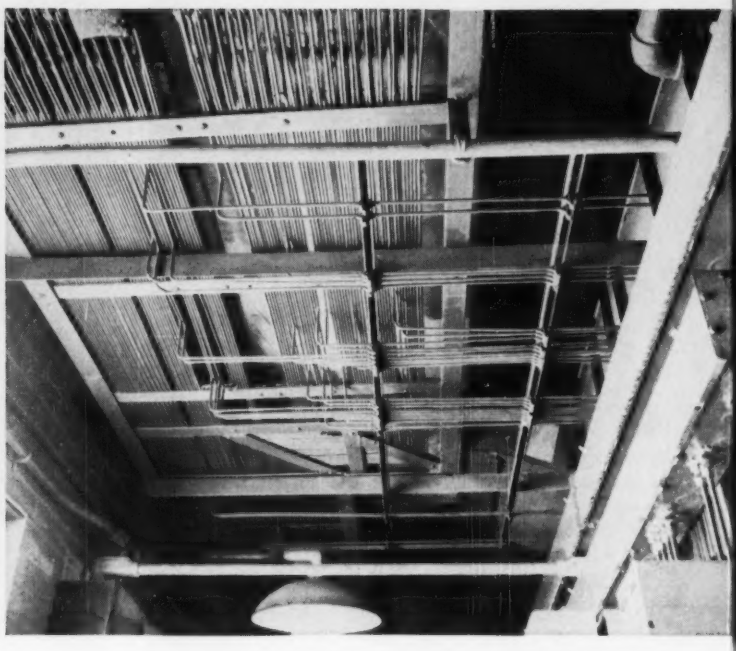


WHEN LOWER FRAME IS MOUNTED ON FOOTINGS, upper sections are simply mounted into position and bolted to the lower section at the corners. This is all it takes to assemble the entire unit!

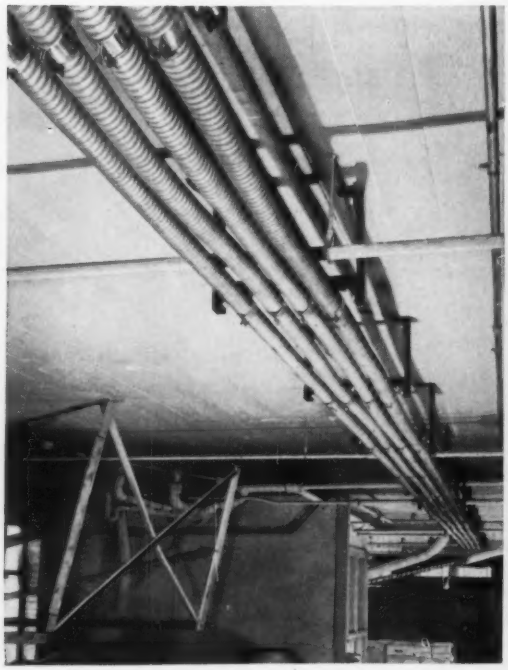
Get This Data on New L-M Feeder-Pak

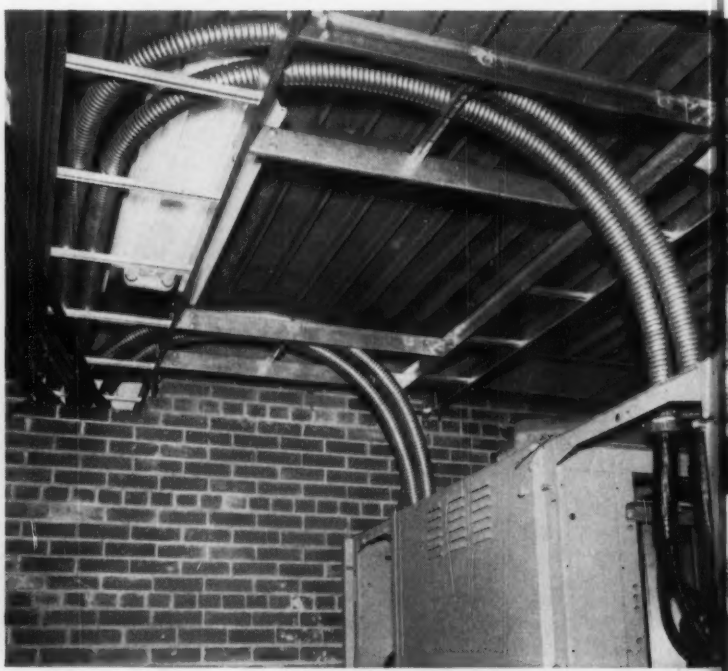
Let us provide complete information on standard equipment and optional accessories. Then check your own present and proposed substation locations to see how this new L-M Feeder-Pak will save you money and man-hours, installation and maintenance. Talk to the L-M Field Engineer. Or write Line Material Industries, Milwaukee 1, Wisconsin. In Canada: Canadian Line Materials, Ltd., Toronto 13, Ontario.



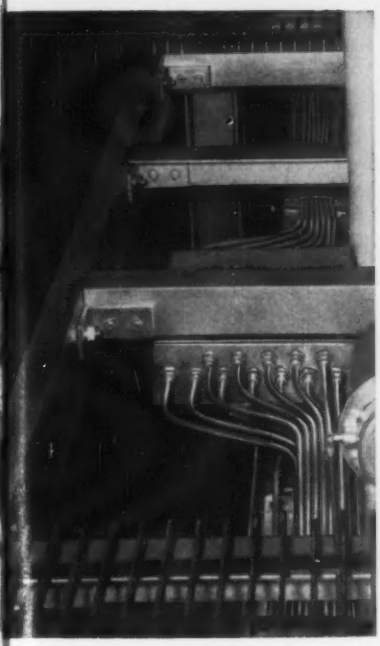


the right combination for





ONLY GENERAL CABLE MANUFACTURES BOTH TYPE MI AND INTERLOCKING ARMORED CABLES. CONTACT YOUR NEAREST GENERAL CABLE SALES OFFICE FOR FULL INFORMATION AND SPECIFICATIONS.



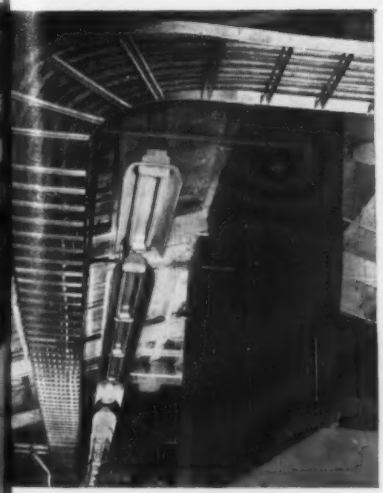
type mi cable

for power distribution, control and lighting circuits

TYPE MI CABLE has solid copper conductors and sheath separated by highly compressed inorganic insulation! Just about indestructible, yet it trains easily over and around obstructions. Naturally it needs no protection: just train it and terminate it. MI is compatible with all other wiring systems. It is completely resistant to moisture, age, nearly all chemicals, temperatures up to 185°F with standard terminations, 482°F with special terminations; and it is approved for use in hazardous areas. It will last forever.

or industrial power

Type MI Cable and Interlocking Armored Cable work together to lower installation costs, minimize space requirements, provide maximum flexibility and accessibility in your cable systems.



inter-locking armored cable

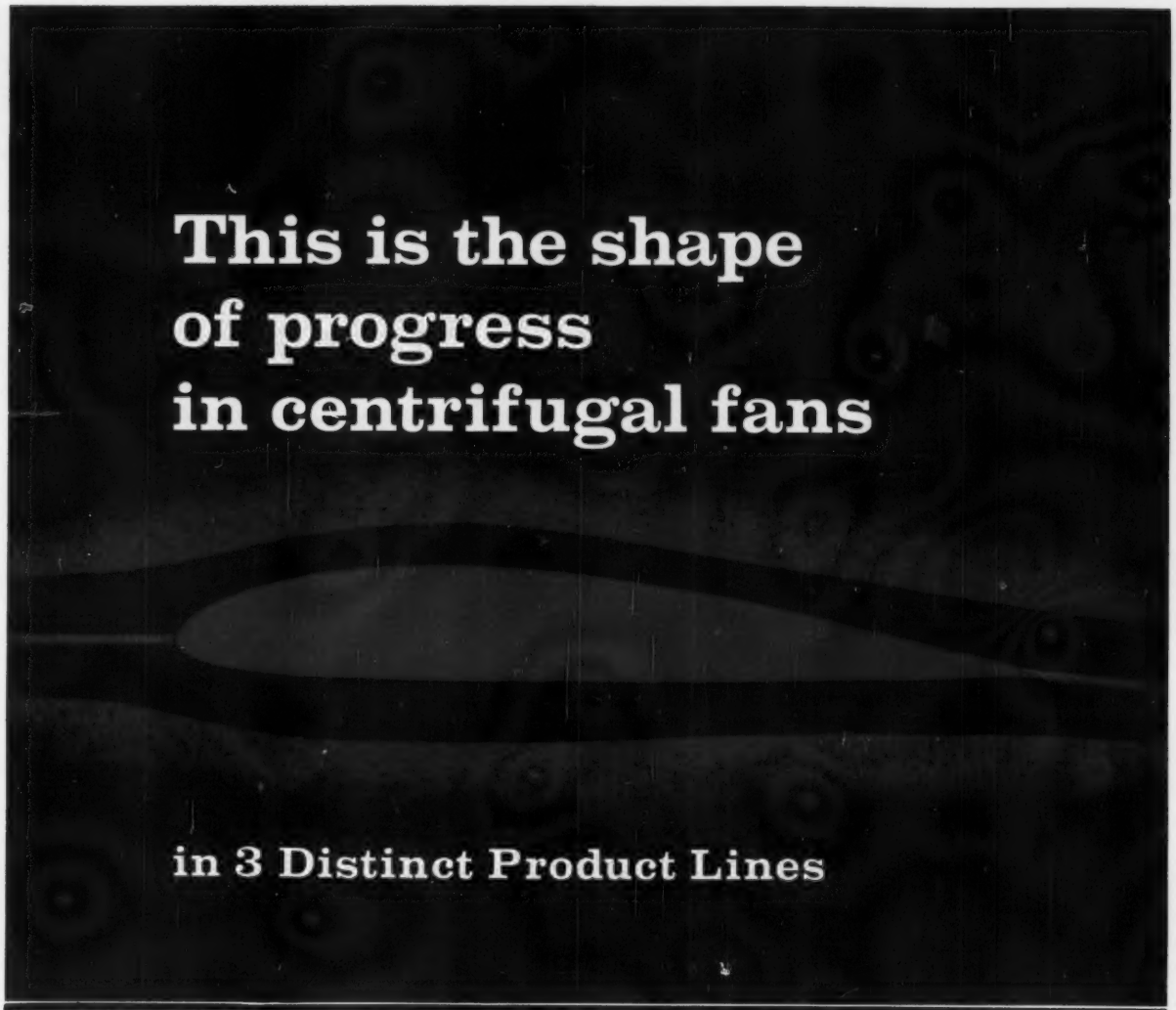
for feeder circuits

GENERAL CABLE'S Interlocking Armored Cable combines flexibility with the mechanical protection normally afforded by metallic conduit, yet has the same current rating as cable in free air. It can be trained to fit the contours of buildings and surrounding equipment and provides a neat, compact installation. It is available in bronze, aluminum and steel and may be applied over most cable insulations in the voltage ranges recommended by industry standards. Protective coverings are available to combat environmental conditions which might cause pitting or corrosion of the interlocking armor.

GENERAL CABLE CORPORATION
65 Offices and Distributing Centers Coast-to-Coast

420 Lexington Avenue,
New York 17, N. Y.

for quality and service specify... **GENERAL CABLE**



FULL RANGE APPLICATION	COMBUSTION AIR FOR CONVENTIONAL BOILERS Series 4000	HIGH PRESSURE AIR FOR PRESSURIZED FURNACE BOILERS Series 2200	PRIMARY AIR Series 2100
Volumes (cfm)	10,000 to 700,000	25,000 to 350,000	6,000 to 50,000
Pressures ("H_2O)	Up to 45"	45" to 90"	Up to 65"

Westinghouse Airfoil* blading offers . . .

Lowest Operating Cost
Highest mechanical efficiency ever: over 92%.

Quieter Operation
Perceptibly quieter in actual operation.

Stable Pressure
Ideally suited to single and parallel operation.

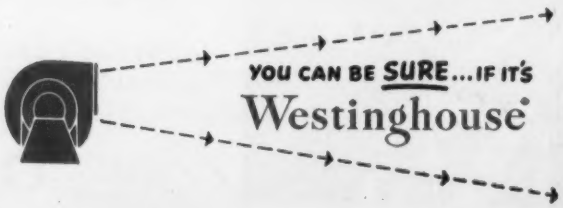
Non-Overloading Power Feature
True self-limiting horsepower characteristic.

Optimum Performance
Sized for specific customer requirements.

Inlet Air Spin Control
Efficient at part loads. Saves power, saves dollars.

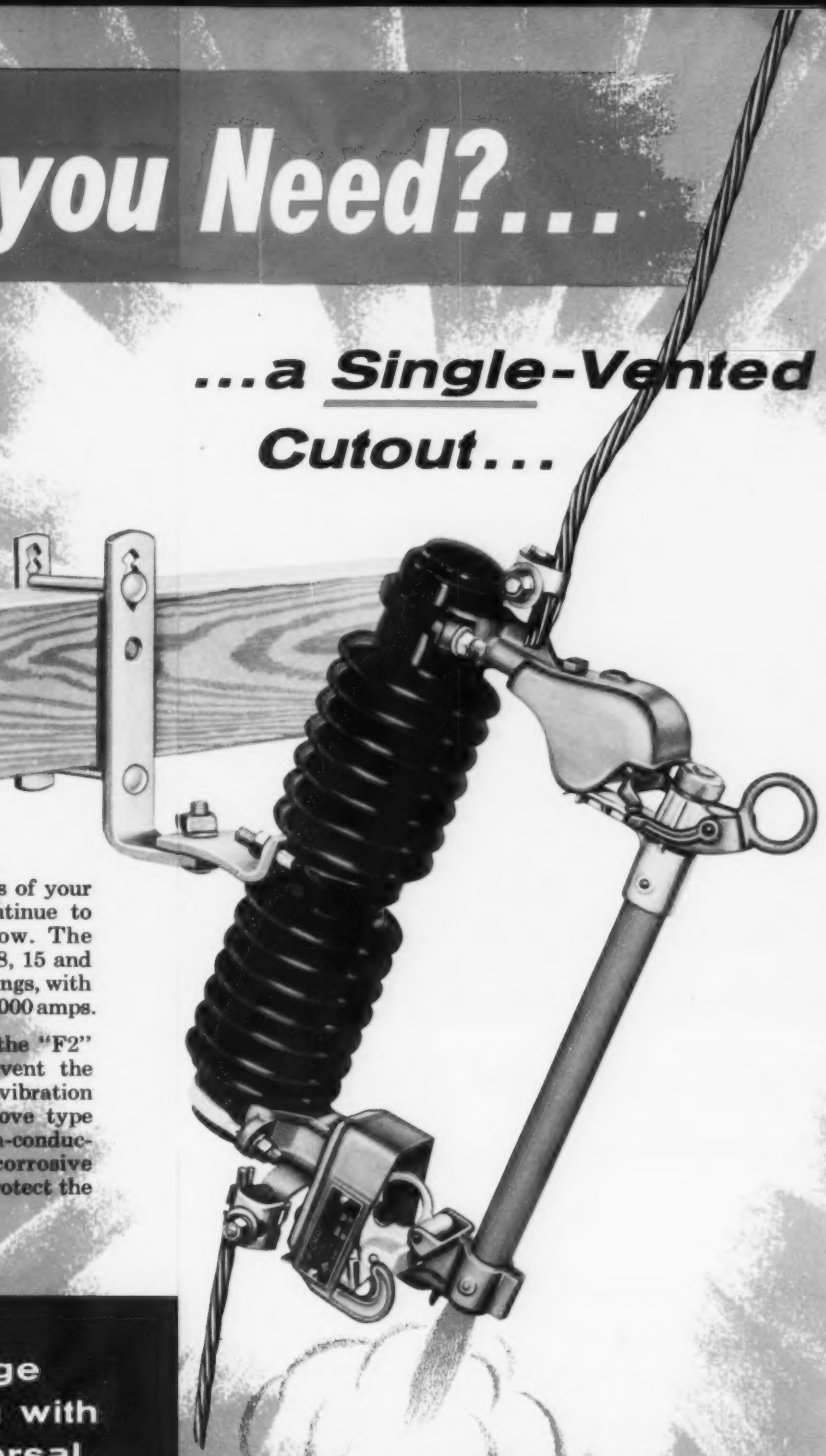
Call your nearest Sturtevant Division Sales Engineer, or write Westinghouse Electric Corporation, Dept. F-8, Hyde Park, Boston 36, Massachusetts.

*Trade-Mark J-80669



What do you Need?...

...a Single-Vented Cutout...



Here is a cutout to meet the needs of your present system and that will continue to protect your system of tomorrow. The Chance "F2" is available in 5.2, 7.8, 15 and 27 KV, and in 100 and 200 amp. ratings, with interrupting capacities as high as 12,000 amps.

Advanced engineering features of the "F2" include: A positive latch, to prevent the cutout from coming open under vibration or shock . . . versatile, parallel-groove type terminals that give positive high-conductivity connections . . . and anti-corrosive bronze sleet hoods to completely protect the vital contact areas.

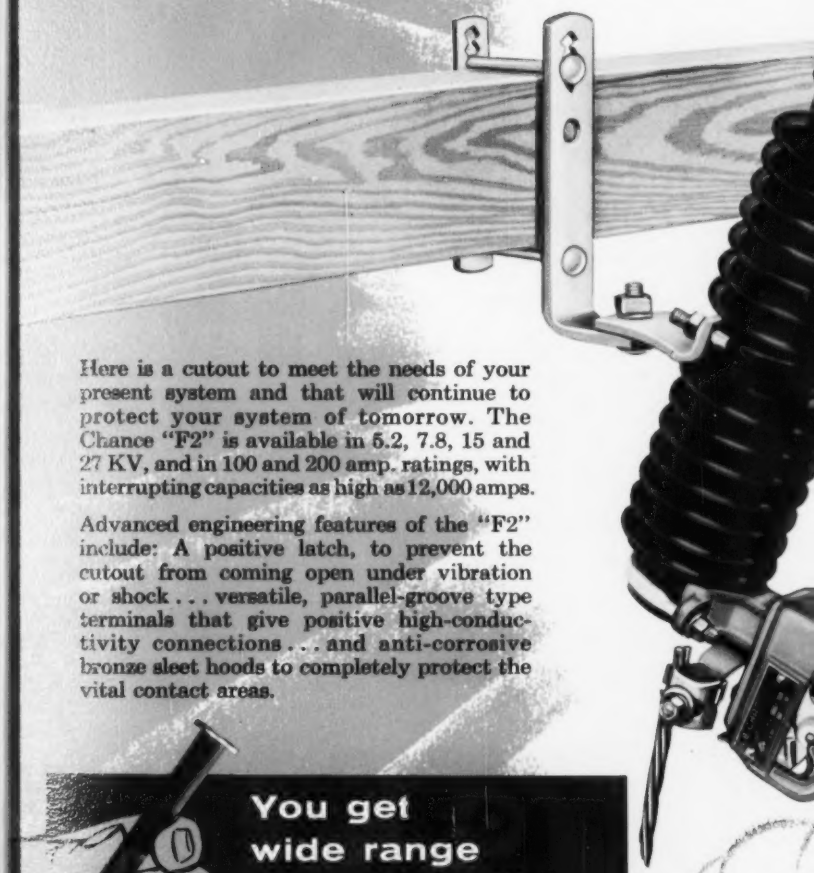
You get wide range operation with any universal fuse link

The fusetubes used in the 100-ampere "F2" all have the same bore diameter—irrespective of the interrupting rating of the cutout. You need buy only one for each voltage rating, and you can use any manufacturer's universal fuselink. The "F2" cutout will interrupt any fault within its rating with a low-cost, expendable fuselink.

...for Low Fault Interruptions?...

What do you Nee

...a



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By using an
"F2" Cutout
low faults, do
for wide-range
or high fault
the advantage
double-venting
of high fault st
or the difficult
with double-ve

The top of the

Breaks

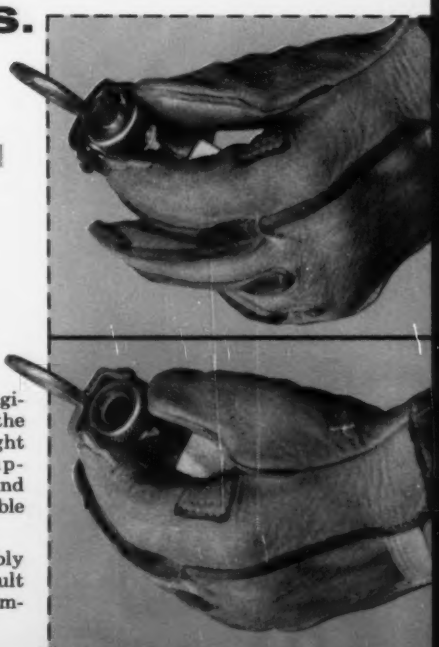
leed?...

...a Double-Vented Cutout for High Fault Interruptions?

YOU GET BOTH

with the CHANCE "F2" ...Complete protection from High, Low or Medium Fault Currents.

Expendable Cap, Small Bore and Link Ejector guarantee interruption of ANY short circuit.

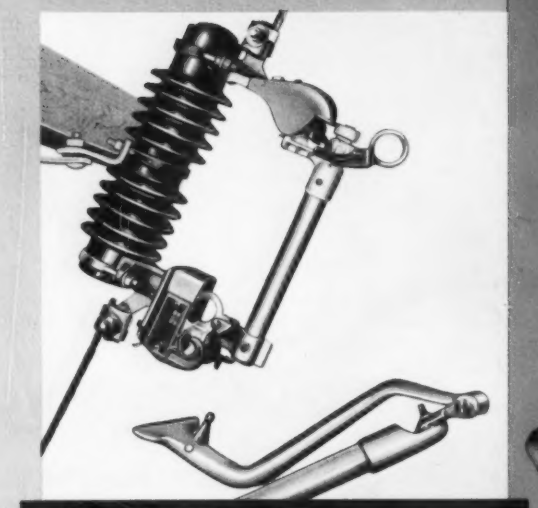


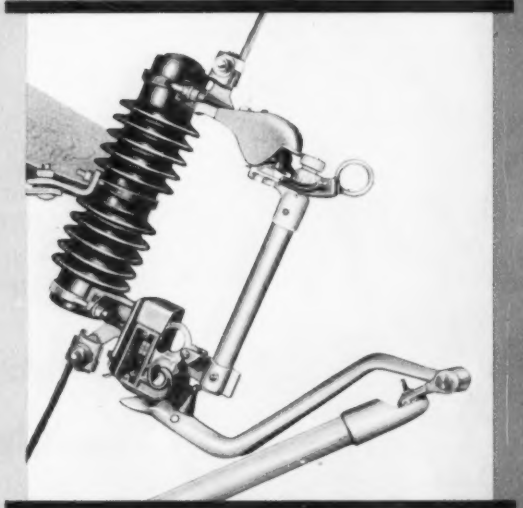
y using an expendable cap, the Chance F2" Cutout gives you single venting on w faults, double venting on high faults r wide-range operation on low, medium high fault currents. This gives you all he advantages of both single-venting and ouble-venting without the disadvantages high fault stress on single-vented cutouts the difficulties of low fault interruption ith double-vented cutouts.

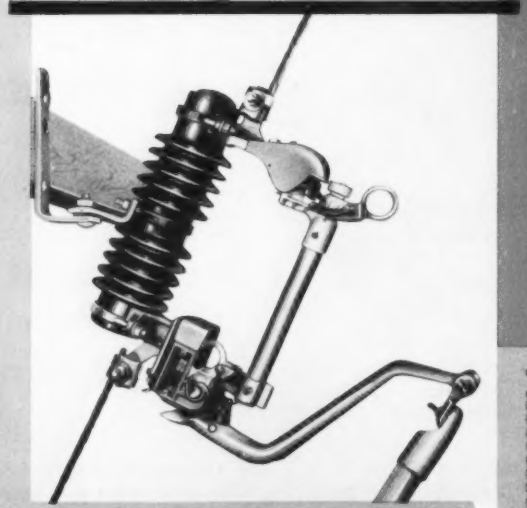
he top of the expendable cap, which seats against the fuse-link buttonhead, is frangible, and tears out when pressure inside the fusetube approaches a value that might burst the tube. The expendable-cap-equipped "F2" single vents during low and medium fault-current interruptions—double vents during a high fault interruption.

A mechanical link ejector makes doubly sure that the "F2" operates on low fault currents. This link ejector is vitally important to load break operation.

reaks Load, too . . . with Link Break Tool (SEE REVERSE SIDE)







NEW... Link Break Tool...

makes any Chance F or F2 Cutout a Loadbreak Cutout!

The Chance Link-Break Tool acts as a portable load break lever. With this tool, any "F2" Cutout you install can play the dual role of standard and loadbreak cutout. You can reduce inventories—cut initial costs—eliminate conversion costs.

It is simple in design—linemen find it easy to use. The silicon-bronze fingerlike projection is easily hooked over the link ejector of the cutout; and a downward pull on the tool breaks the fuselink and the load—just like a conventional loadbreak cutout. The tool is used with standard universal poles.

A. B. CHANCE COMPANY
CENTRALIA, MISSOURI
A. B. Chance Co. of Canada, Ltd., Toronto

ABC INDUSTRIES

SPECIAL INTRODUCTORY OFFER!

To prove the unusual advantages of this link-break tool, the A. B. Chance Company will include a FREE tool with every order of 100 or more "F2" Cutouts. This offer is limited—it expires October 31, 1959. Attach this certificate to your order.

CK89-11

A. B. CHANCE CO., Centralia, Missouri

This certificate entitles the purchaser to _____*FREE Link Break Tools when accompanied by a purchase order for 100 or more Chance F2 Cutouts.

*One FREE Link Break Tool for every 100 F2 Cutouts purchased.

Ship to:

Name_____

Company_____

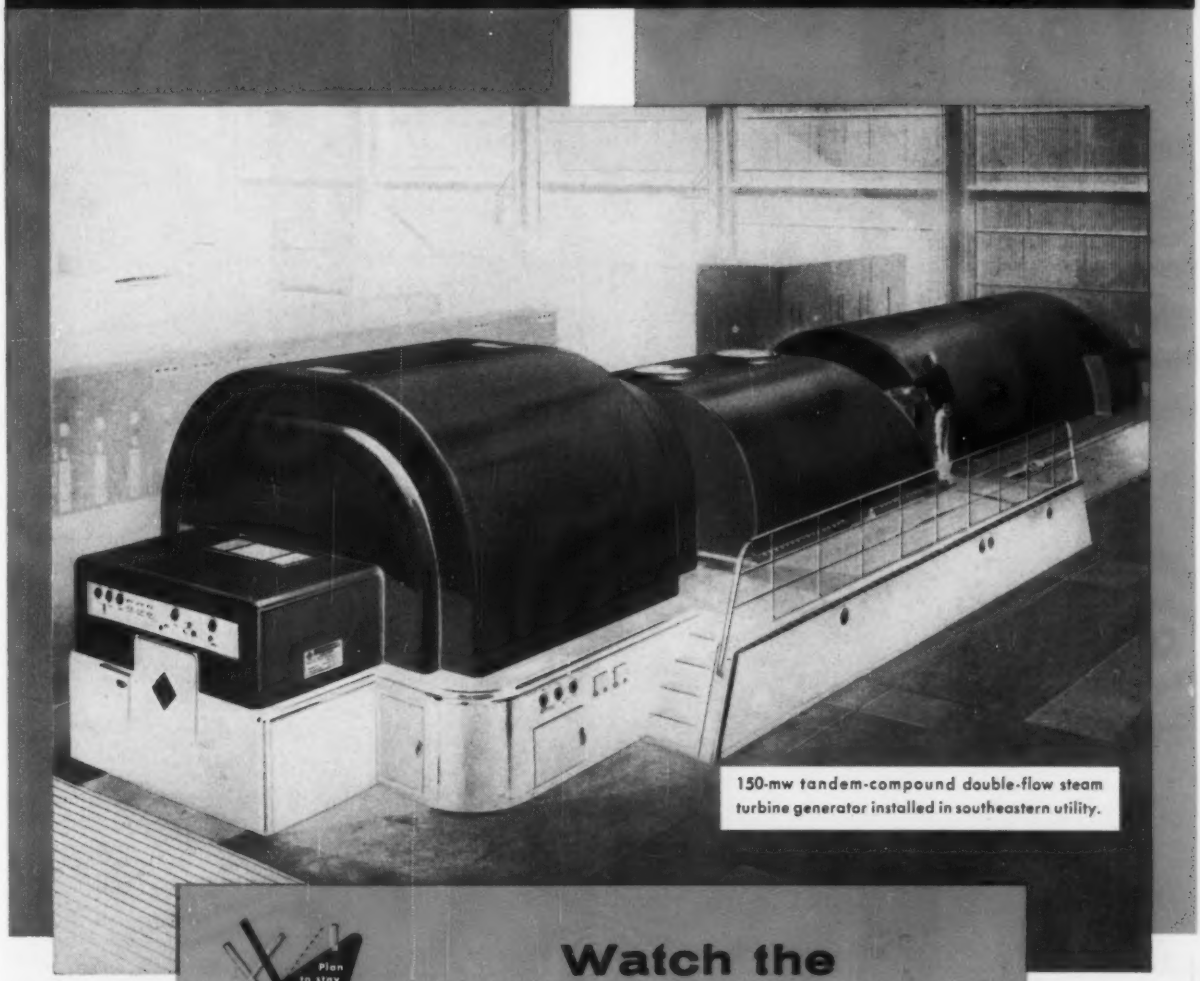
Address_____

City_____ State_____

Purchaser's Order No._____

OFFER EXPIRES OCTOBER 31, 1959

ALLIS-CHALMERS modern line for '59



150-mw tandem-compound double-flow steam turbine generator installed in southeastern utility.

Plan to stay ahead... MODERNIZE!

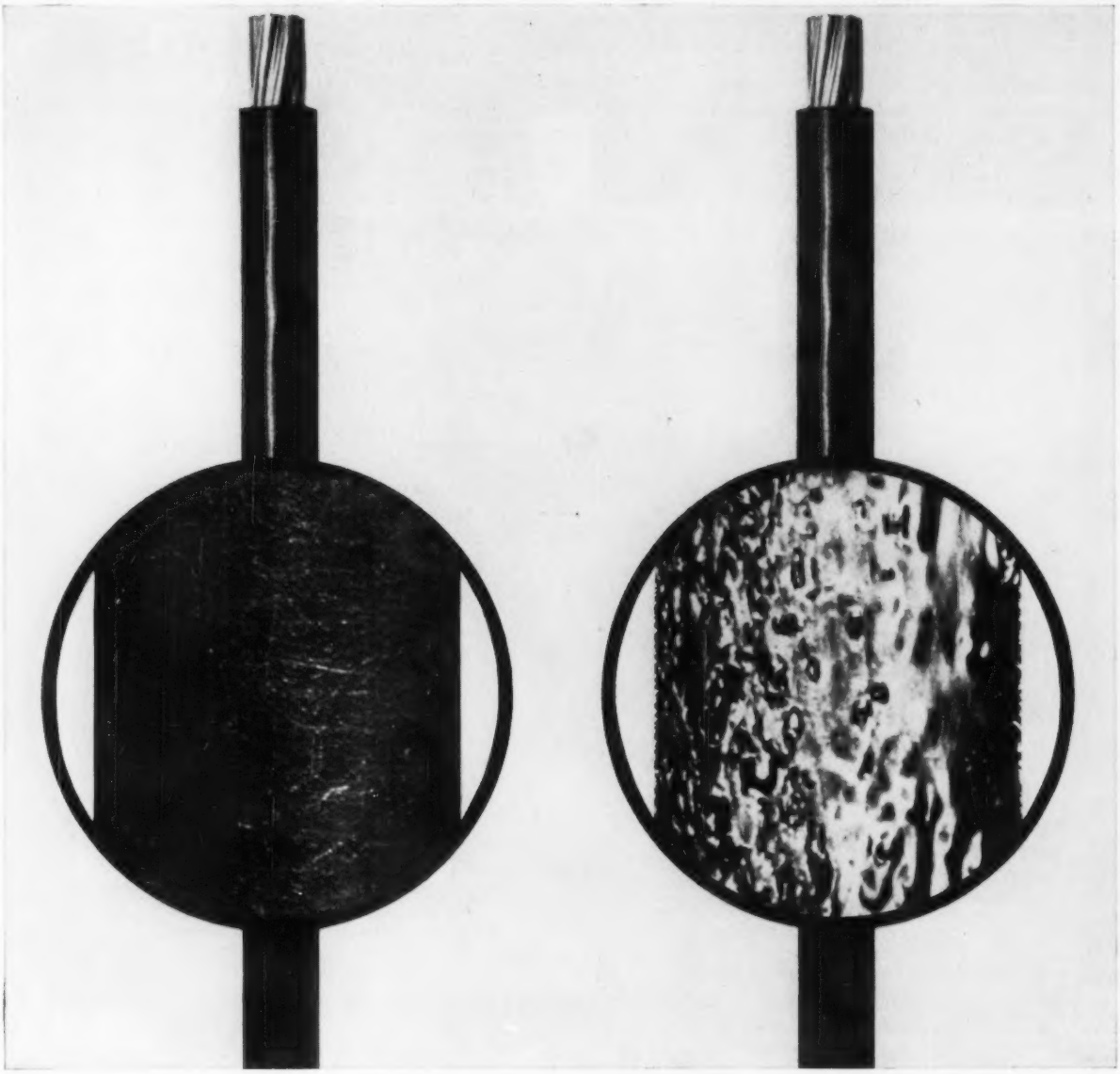
Watch the Modern Generation!

IT'S bigger — stronger — better looking — can do more! And most important to you, we're describing Allis-Chalmers equipment for modern power generation . . . ready to serve you.

This "generation" was born of Allis-Chalmers engineering and development, including such important advancements as supercharged cooling of generators, close-coupling of steam turbines, welding of condenser tubes, and low silhouette station auxiliary switchgear.

Now this "Modern Generation" is ready to go to work for you. Contact your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS A-C A-5987-E



QUALITY CONTROL MAKES THE DIFFERENCE IN ALCOA COVERED CONDUCTOR

Most covered conductor looks about the same . . . and, for the first few years, *may* perform about the same. But looks can often be deceiving and sometimes very costly. For the fact is: all covered conductor is not alike. There's very often a big difference . . . and, in Alcoa covered conductor, that big difference is quality control.

Consider the problem of moisture in polyethylene covers, shown in the enlarged illustration above. Though moisture is not absorbed by polyethylene, it will cling to polyethylene if proper manufacturing controls are not observed. Such moisture can actually be trapped in the polyethylene batch as it goes through the extruder . . . causing pin holes, voids, a spongy covering . . . creating weaknesses which contribute to reduced operating life. But in the manufacture of Alcoa covered conductor, this problem never has a chance to occur. Continuous quality control prevents these hidden weaknesses by eliminating their causes.

Alcoa covered conductor undergoes the most exhaustive series of tests in the industry . . . tests before, during and after manufacture to make sure you receive the very best product which can be made by the most modern production methods.

Recognize this big difference of quality control in your installations by specifying Alcoa . . . in neoprene, polyethylene or special coverings. No extra cost, but savings through added reliability and longer life are bound to be substantial. Aluminum Company of America, 2110-F Alcoa Building, Pittsburgh 19, Pa.

Your Guide to the Best in Aluminum Value

For exciting drama watch "Alcoa Presents" every Tuesday, ABC-TV, and the Emmy Award winning "Alcoa Theatre" alternate Mondays, NBC-TV

ALCOA ALUMINUM

ALLIS-CHALMERS modern line for '59

Low cost, high speed 4.16-kv oilless units replace obsolete under-capacity breakers

Eliminate a fire hazard, reduce maintenance, provide modern high speed interruption, plus adequate interrupting and continuous-current capacity with Allis-Chalmers replacement breakers.

Existing cables and structures can be used with these replacement breakers. Low cost modernization can thus be provided in power-generating and substation facilities. The air magnetic breaker, together with its sturdy metal enclosure, can be installed in the masonry cell or open-type iron pipe framework previously occupied by the obsolete oil circuit breaker. Buswork, disconnect switches, current transformers, and cables can all be retained because of low height.

Modern features of breaker include: 5-cycle interruption, flame-retardent insulation, safety interlocks, full steel floor in breaker compartment, automatic shutters, one man disassembly. Interrupting capacities from 75,000 to 250,000 kva available.

For details contact your nearby A-C office or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

A-C

ALLIS-CHALMERS

A-5977-E

Even your dome light draws more current than MOTRAC 2-way radio!

Motorola ends costly power drain problems and idling expense with the first fully transistorized receiver and power supply

What makes Motorola MOTRAC radio the most economical and reliable 2-way radio unit in the annals of mobile communications? Not just one or two new features, but a score of revolutionary design advancements that bring you the very finest set ever engineered.

1. On standby—the MOTRAC receiver draws only a trickle of current—actually 80% less than conventional units—with an occasional increase to maintain crystals at proper temperature for precise on-frequency operation (even your dome light draws more current than MOTRAC radio). Yet, this radio is always poised for instant reception, thanks to its fully transistorized receiver. Result: no life-shortening battery drain . . . no more costly, unnecessary engine idling.

2. MOTRAC radio eliminates the most common maintenance problems: vibrators in the power supply and tubes in the receiver. All are replaced by stabilized long-life transistors.

3. Up to 40°F cooler operation means less aging and strain on components. Reason: no more receiver tube filaments; a more efficient power supply; a battery saver switch to cut off transmitter filaments; and two separate heat sinks—one for power supply, another for transmitter output tubes.

4. The MOTRAC receiver operates directly from the 12-volt battery; its low voltage operation results in less electrical strain on components, assures long life.

5. Traditional Motorola engineering and production excellence are evident throughout MOTRAC radio. Transistors undergo three separate checks, including a week of stabilization at 185°F. Only industrial-type tubes, especially suitable for the rigors of mobile operation, are used in the transmitter.

6. Patient production testing continues under stringent quality control procedures. First, each module is tested. Then each chassis is independently checked. Next, each radio is tested as a composite whole. Finally, the entire radio and associated accessories are checked out as a complete operating system.

7. MOTRAC radio is conservatively designed. The receiver has *even higher* reserve gain than conventional Motorola units to assure *peak performance* for many years. Also, power supply transistors are operated under an exceptionally high safety factor to assure extended service life.

8. Completely independent receiver and transmitter chassis, with no power supply in common, assure reliable reception regardless of transmitter performance.

9. MOTRAC radio offers you 2½ to 3 times higher audio output than conventional sets.

10. MOTRAC radio is designed for split-channel operation. *Both* receiver and transmitter meet critical split-channel stability frequency requirements.

Experienced users have been field testing MOTRAC radios for many months. The results are in—and they're excellent. We'd like to tell you *all* about them. Write, wire or call: Motorola Communications & Electronics, Inc., A Subsidiary of Motorola, Inc., 4501 West Augusta Blvd., Chicago 51, Ill., SP 2-6500. MOTRAC is a Motorola, Inc. trademark.

ALLIS-CHALMERS modern line for '59

Caliband Control

Adds accuracy • Cuts human error • Saves time

For the first time you can adjust or test voltage level without changing customer voltage or interrupting regulating service. In addition, human error is eliminated because compensator elements need not be set to zero before testing voltage level. *Caliband* control does it automatically. All of this saves time.

Caliband unit makes Allis-Chalmers regulator controls simpler to set and more accurate.

Caliband control is standard on all Allis-Chalmers regulators. It may be purchased separately, however, for use in adjusting or testing voltage level on earlier model Allis-Chalmers regulators on your system.

See it in action! *Caliband* control can be demonstrated on your desk with an actual unit. Contact your nearby A-C office or Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

Plan to stay ahead... MODERNIZE!

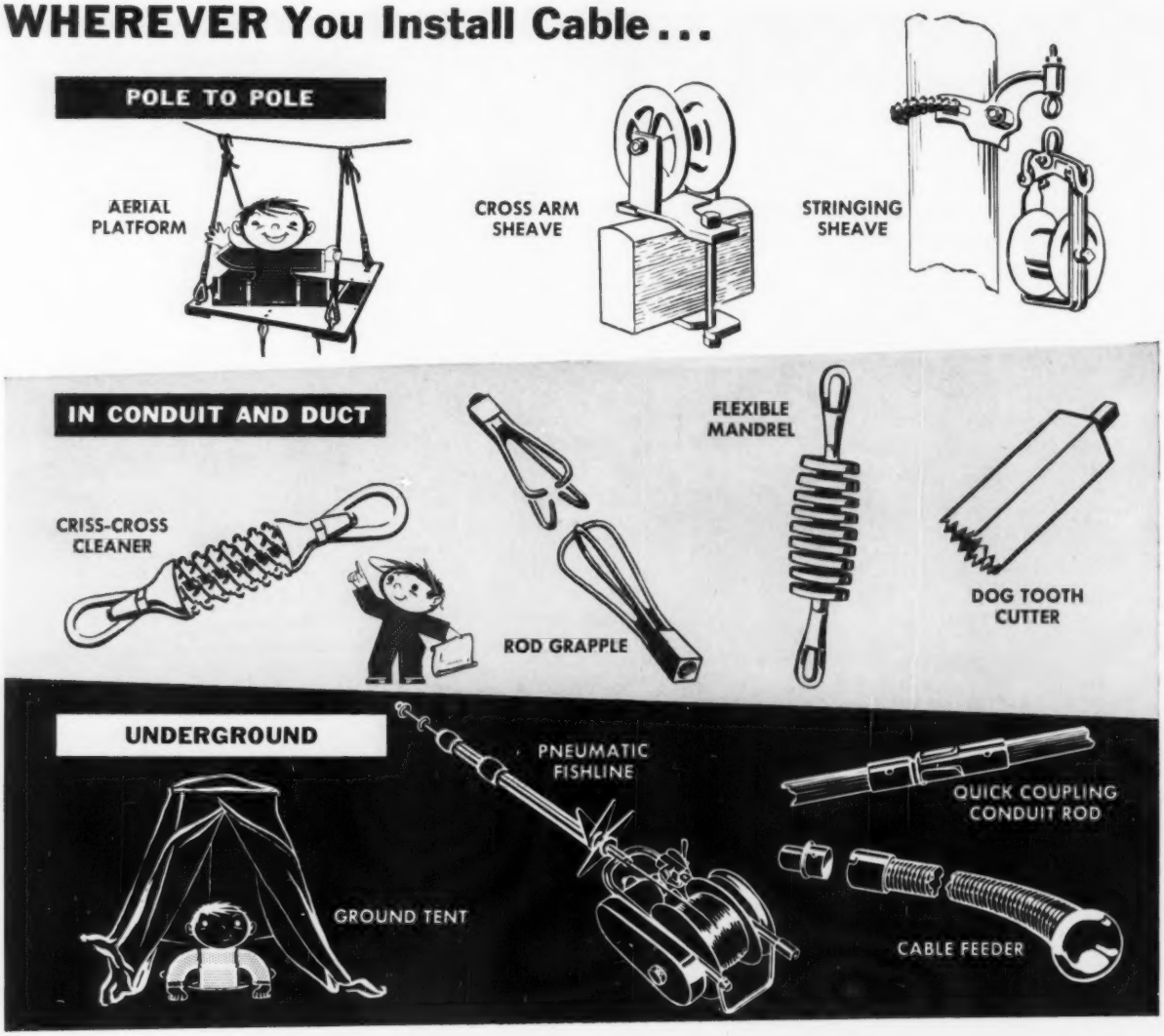
Caliband is an Allis-Chalmers trademark.

Originators of 5/6% step regulators

ALLIS-CHALMERS

A-1040-E

WHEREVER You Install Cable...



COPE HAS THE EQUIPMENT TO SPEED THE JOB!

There's a Cope tool specifically designed for virtually every cable installation job! For example, Cope Pneumatic Fishline is a compact, air-operated device that enables you to fish underground duct in a matter of minutes. Cope quick coupling Conduit Rods, Rod Grapples and Pullers, Flexible Mandrels and Cable Feeders are designed to facilitate rodding and feeding of cable in a wide variety of conduit layout situations. Cope manhole cover hooks, ladders and ground tents assure cost-saving efficiency on underground jobs.

For aerial cable installations, Cope Cross Arm Sheaves, Stringing Sheaves and Angle Cross Arm Sheaves speed and simplify the toughest installation job. Each is available in a size to meet your particular cable requirements.

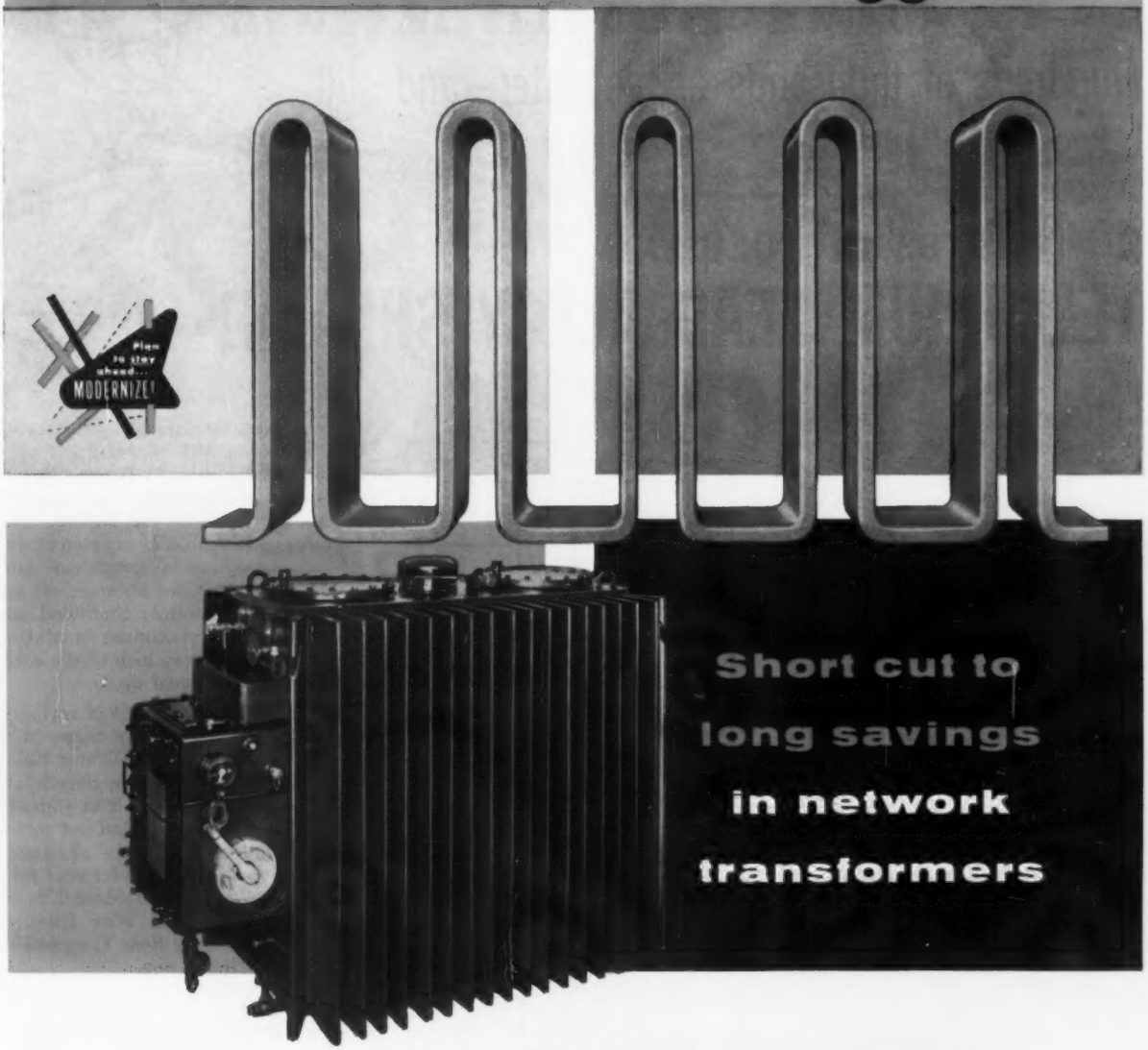
In addition Cope's Engineering Dept. is always available to assist you in the design or modification of these tools for specialized requirements. Cope Catalog 65 describes the complete line of Cope Cable Installation Equipment. Learn how you can save time and costs on every installation by having the right Cope tool on hand! **Call your authorized Cope Electrical Wholesaler for information.**

COPE

Serving the electrical industry since 1885

Division of **ROME CABLE CORPORATION • COLLEGEVILLE, PENNSYLVANIA**

ALLIS-CHALMERS modern line for '59



Reduced Size and Weight Cut Installation Costs

Smaller vault requirements per kva is another economy advantage of this redesigned unit. With more compact units to handle, work crew efficiency is increased. And, of course, increased kva may be installed in existing vaults.

Corrugated tank surface simplifies cleaning and painting

Fluted tank design with its flowing surface continuity adds years of serviceability because: (1) Sharp corners and crevices are eliminated. (2) Easy visual inspection facilitates checking surface condition. (3) When required, reconditioning is simplified.

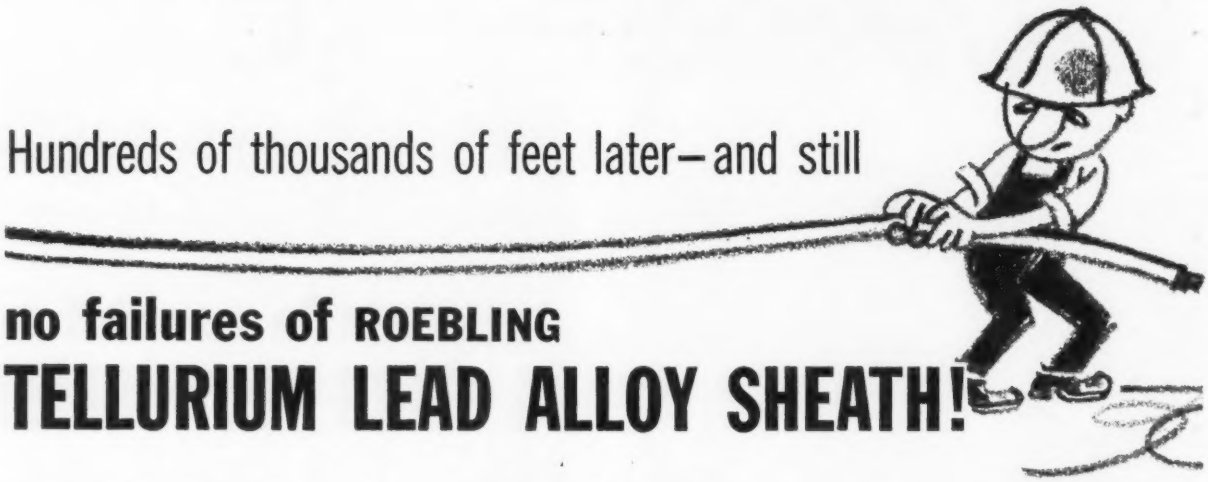
The proved maintenance economy of corrugated cooling surfaces is just one of the many more-for-your-money features of the new Allis-Chalmers network transformer.

For complete information, call your local Allis-Chalmers representative or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.

A-1017-E

ALLIS-CHALMERS

Hundreds of thousands of feet later—and still



no failures of ROEBLING TELLURIUM LEAD ALLOY SHEATH!

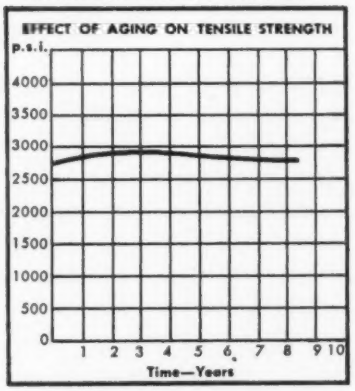
More proof: Tensile strength and elongation remain virtually unchanged, after eight years aging.

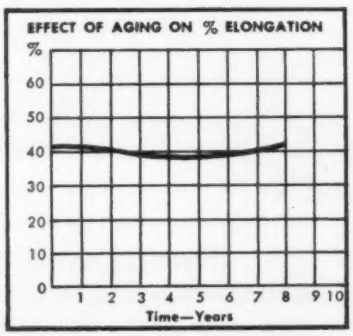
The first Roebling Paper Power Cable with the extraordinary Tellurium Lead Alloy Sheath went into service over five years ago. Since then hundreds of thousands of feet have been put to work. The record? Not a single failure! This remarkable record of service on energized circuits proves conclusively that Roebling Paper Power Cable with Tellurium Lead Alloy Sheath gives you maximum service, with maximum savings!

What's more, we asked the people who bought this cable to put it into the toughest service possible—in such installations as high risers, grades and underground installations where large cable movements and high temperatures prevail. And this gruelling service bears out what we've always maintained: Roebling Tellurium Lead Alloy Sheath has long term stability when it comes to tensile strength and elongation, high resistance to creep and bending fatigue.

These graphs of laboratory tests show effect of aging on tensile properties of Tellurium Lead Alloy Sheath.

TELLURIUM LEAD ALLOY SHEATH...



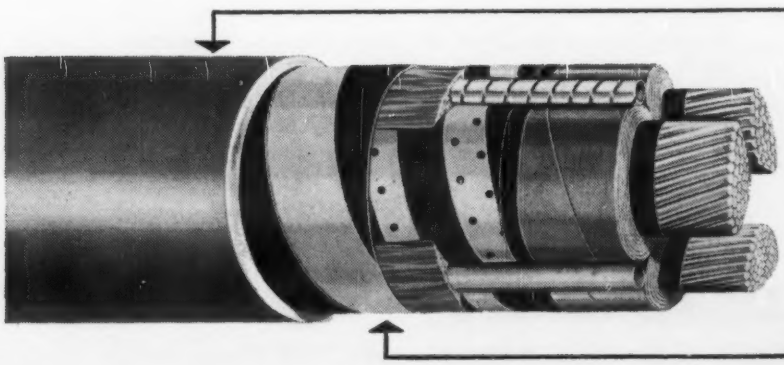


The exceptional quality of this sheath is one reason why Roebling has more Tellurium Lead Paper Power Cable in service than any other manufacturer. *Another* reason is the superb *inner* quality of this cable. Every step of construction represents scrupulous care. The paper tapes, for instance, are applied under uniformly controlled tension, to assure maximum insulation qualities. And every inch of the cable is tested—then tested again.

You benefit in all kinds of savings—not the least of which is *money*—when you put Roebling Paper Power Cable with Tellurium Lead Alloy Sheath into service! Don't you owe it to yourself, and your company, to find out more? An interesting, profusely illustrated book is yours free. Write for your copy ...right now! Ask for Technical Bulletin 205-C. Electrical Wire Division, John A. Roebling's Sons Corporation, Trenton 2, New Jersey.

ROEBLING

Branch Offices in Principal Cities
Subsidiary of The Colorado Fuel and Iron Corporation



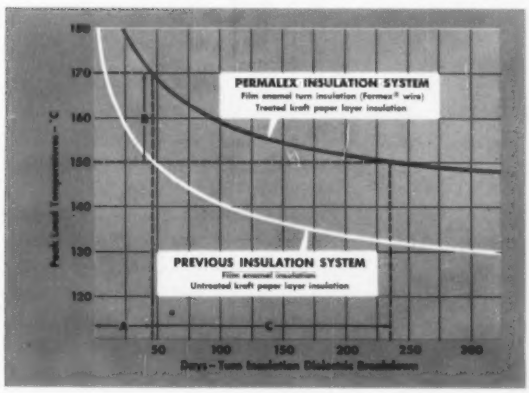
Uniform physical properties are easily achieved in a single operation with the tellurium alloy. This unique feature is but one of several which distinguish the tellurium alloy from other fatigue-resistant lead alloy sheaths.

Mammoth new taping and cabling machines, and the finest obtainable materials, are used to produce the carefully constructed "heart" of Roebling Paper Power Cables.

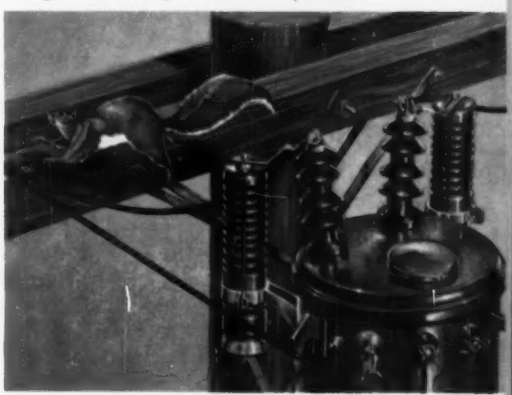
GENERAL ELECTRIC ANNOUNCES . . .

NEW 1959 Distribution Transformer

NEW Permalex* insulation permits 20% additional load with full transformer life.



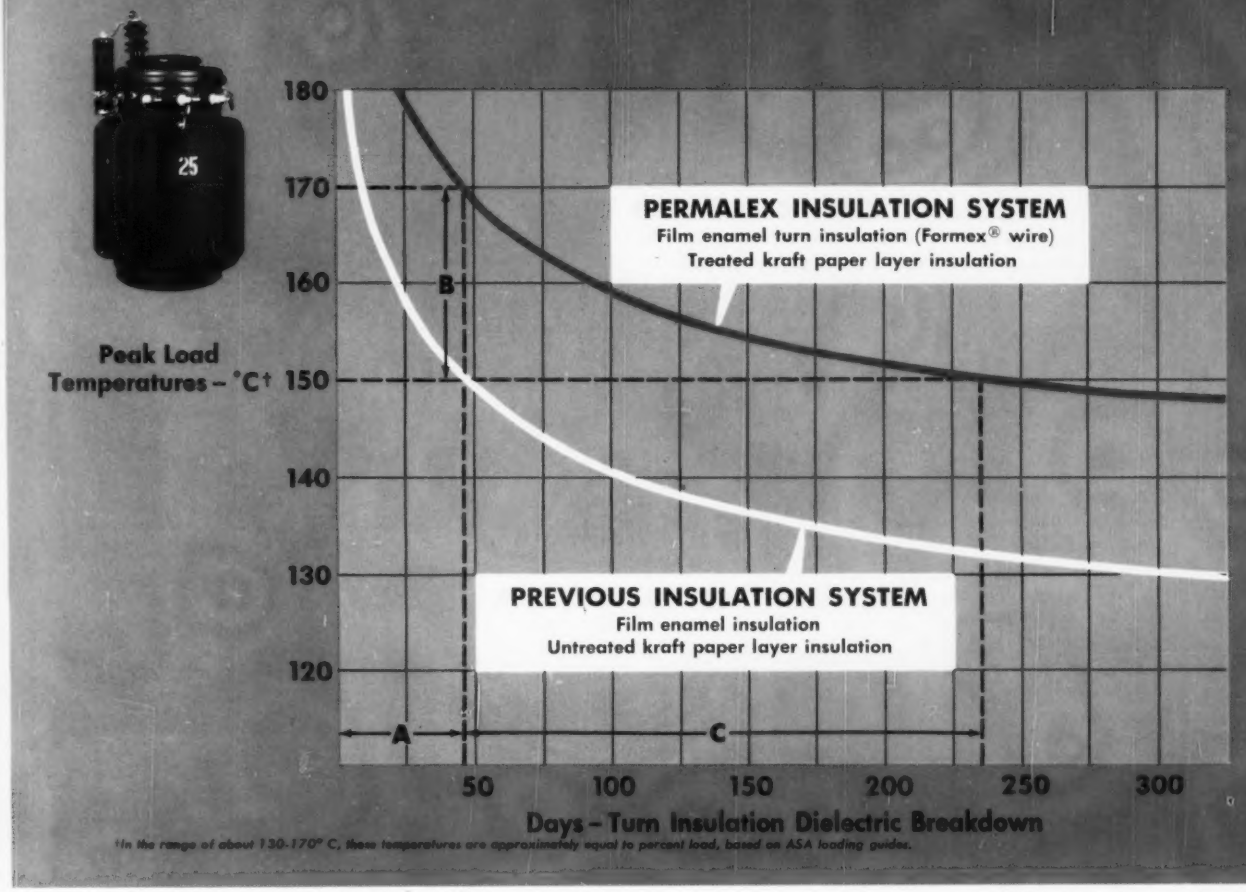
NEW Melalast* finish prevents service outages caused by birds and squirrels.



*Trademark of General Electric Company

GENERAL ELECTRIC

NEW 1959 GENERAL ELECTRIC DISTRIBUTION TRANSFORMER



NEW 1959 G-E DISTRIBUTION TRANSFORMERS, with Permalex insulation, provide utilities important savings in operating costs. For example, A shows life of former transformer at 150% of rated load. B shows how Permalex insulation increases loadability 20% with same life. C shows increased life—almost 400%—at present loads with new General Electric Permalex insulation system.

PERMALEX

Insulation Gives G-E Transformers Exclusive 20% Added Loadability with Full Transformer Life

Standard on the new 1959 General Electric pole-type distribution transformer, Permalex insulation brings electric utilities important savings in operating costs. You can get increased transformer loadability, or increased transformer life, or a combination of both. The new transformer will be available through 167 kva.

Users can increase transformer loading an additional 20% of nameplate rating and still get full transformer life — thanks to the increased loadability permitted by Permalex, the new General Electric insulation system.

Utilities who normally remove transformers, or add units, when peak load on the transformer reaches 150% of rating, for example, can now load to 170% and obtain the same long transformer life as before. Or you can utilize increased thermal stability to get 400% longer life with present load, or a combination of both increased life and load.

WHY PERMALEX GIVES EXTRA STRENGTH

The new Permalex insulation system uses a cyanoethylated kraft insulation material, patented by G.E., to preserve high dielectric strength. Cyanoethylation of the kraft retards formation of moisture, released by cellulosic materials when subjected to load.

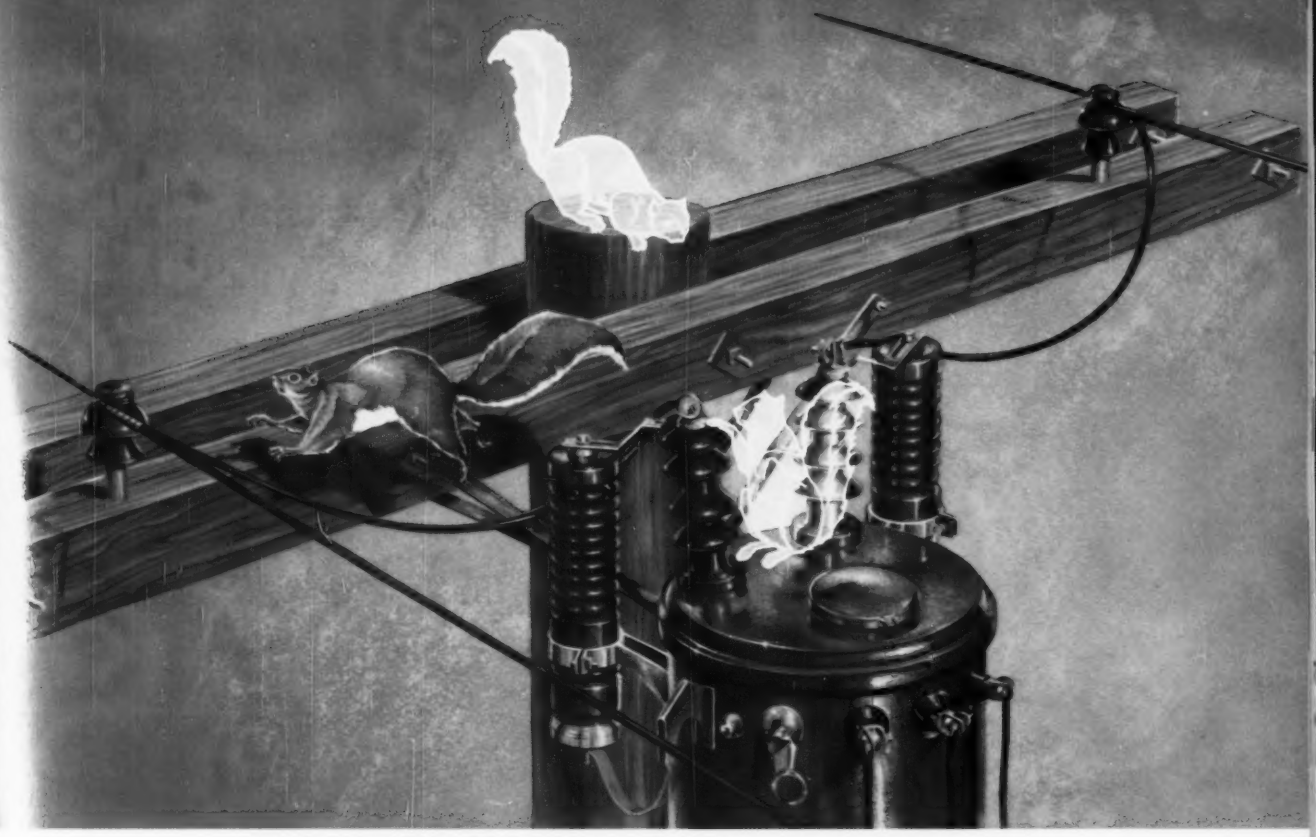
In the Permalex insulation system, cellulosic materials are treated in raw pulp stage to replace "OH" chemical groups with "Cyanoethyl" groups. Since this retards water formation, the new G-E transformer withstands better the higher temperatures which accelerate aging of insulations not treated by the cyanoethylation process.

PERMALEX IS COMPATIBLE

Permalex is completely compatible with everything in the transformer, is clean, safe and odorless. It has no detrimental effect on components such as enamel film insulation, steel or aluminum parts, or oil.

The new 1959 General Electric distribution transformers with exclusive Permalex insulation will be available at no price premium.

REDUCES UTILITY OPERATING AND MAINTENANCE COSTS



MELALAST FINISH ON COVERS of new G-E distribution transformers prevents outages caused by birds and squirrels, eliminates need for special "bird guards" or terminal taping. Slight shock sends visitors safely on their way, as shown in the artist's conception above.

MELALAST

Finish on Cover Prevents Outages Caused by Squirrels and Birds

New savings in installation and maintenance expenses are now possible with Melalast finish on covers of General Electric pole-type distribution transformers. This cost-saving feature is provided at no price premium on all ratings above 5 kv.

Melalast finish is a modified epoxy resin which insulates birds and squirrels from the grounded cover, thus preventing outages and customer complaints. It is applied to both main and handhole covers and cover bands.

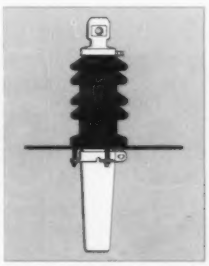
The Melalast coating protects from line to ground but still provides a slight shock, sending squirrels and birds safely on their way. Melalast finish also provides improved corrosion resistance.

Melalast finish, from the G-E Pittsfield laboratories, is another added value benefit which utilities derive from General Electric research and development.

GENERAL ELECTRIC

OTHER ADDED VALUE BENEFITS OF NEW G-E DISTRIBUTION TRANSFORMER

NEW BUSHING on the 1959 General Electric distribution transformer permits replacement of high-voltage fuse without removing the bushing. This helps reduce maintenance costs. In addition, positive method of internal clamping eliminates external parts, potential sources of corrosion.

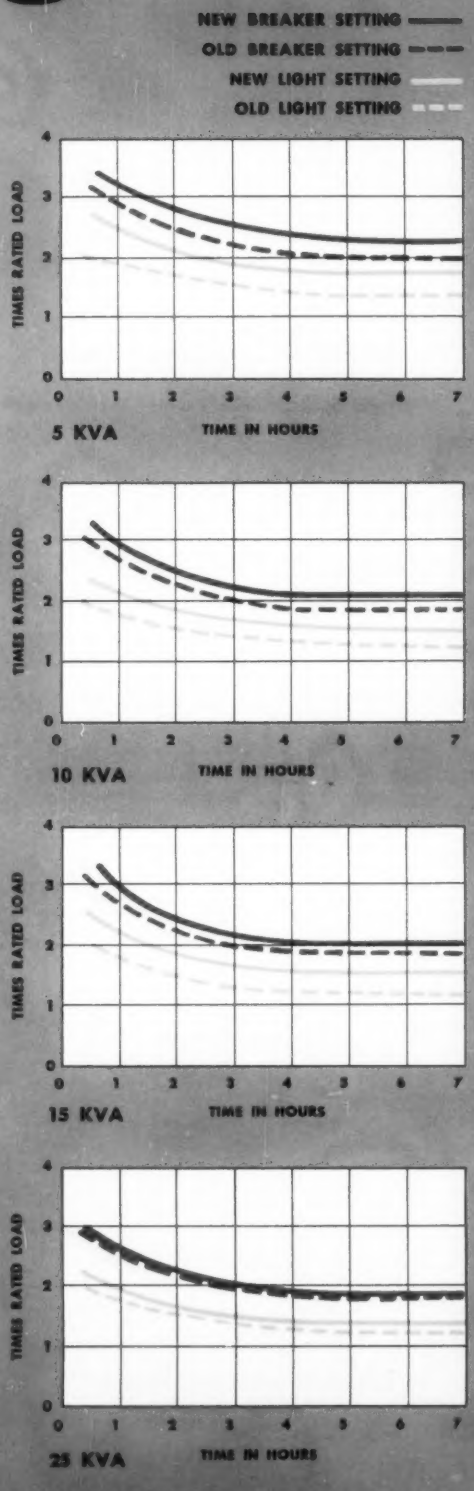


NEW ROLLED-UNDER BASE on G-E distribution transformers through 100 kva reduces maintenance costs by minimizing finish damage from scraping. Minimizes floor and truck-bed scuffing.

NEW LIGHT AND BREAKER SETTINGS make usable the extra loadability possible with Permalex insulation. Graphs and further details on following page.

→

NEW 1959 GENERAL ELECTRIC DISTRIBUTION TRANSFORMER REDUCES UTILITY OPERATING AND MAINTENANCE COSTS



LIGHT AND BREAKER SETTINGS are uprated on new G-E Type HSBA distribution transformers. The new settings make usable the increased loadability which Permalex insulation provides. Curves are based on 7200-volt ratings, 75 percent initial loading, 35 C ambient.

NEW Higher Light and Breaker Settings Make Extra Loadability Usable

The new 1959 General Electric distribution transformer establishes a logical, comfortable load-growth margin over the entire kva range for self-protected units. New light and breaker settings provide greater margins than the pre-1956 settings, thus avoiding "hot-weather" tripouts as air conditioning loads increase. Yet settings are not unrealistically far apart.

The new light and breaker settings reflect utility requirements to avoid both the too narrow margins prior to 1956 and too wide margins which make it difficult, if not impossible, to use the light as a warning for the coming changeout. Settings on the new General Electric Type HSBA distribution transformers make it simple to plan changeouts in advance, without any change in utility operating practices. And only on the new G-E transformer do you get these higher light settings and the resulting operating savings.

A new, red-bordered nameplate on transformers with Permalex insulation provides easy, positive identification of the increased loadability for both conventional and self-protected transformers. For users of HSBA transformers this nameplate will also identify the increased breaker settings. Important as it is, Permalex insulation is just one of . . .

10 REASONS WHY GENERAL ELECTRIC IS YOUR BEST TRANSFORMER BUY

1. **New Permalex Insulation** increases transformer loadability by 20%.
2. **New Melalast Finish** on cover ends outages caused by animals.
3. **Formex Wire** helps cut size and weight, makes handling and changeouts easier.
4. **AL/CU Terminals** provide sure electrical contact with both aluminum and copper conductors.
5. **Strenicor Clamps** virtually eliminate secondary terminal failures and resulting service calls.
6. **Stainless Steel Bands, Nitrile Rubber Gaskets** simplify maintenance, resist corrosion.
7. **Impulse Testing** at factory assures extra years of reliable service.
8. **Self-Protected Transformers** are equipped with superior Thyrite* Magne-valve arresters.
9. **Computer-Controlled Ordering System** speeds delivery, helps reduce utility inventories.
10. **Careful Packaging,** guided by impact and vibration tests, cuts shipment damage.

Ask your G-E sales engineer for further details on the savings provided by new Permalex insulation and Melalast finish—and the 10 reasons why General Electric is your best transformer buy. Or write for bulletin GEA-6070 to G.E. Co., Section 431-85, Schenectady 5, N. Y.

*Reg. Trademark of G. E. Co.

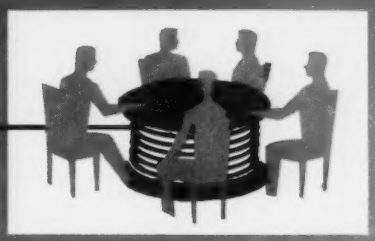
Progress Is Our Most Important Product

GENERAL ELECTRIC

WIRE AND CABLE

DU PONT

ROUND TABLE



New Du Pont study on corona proves ALATHON® polyethylene resin ideal for power-cable insulation

You have asked . . .

Q: What is the effect of voltage stress on polyethylene?

A: When exposed to voltage stress alone, polyethylene can withstand surprisingly large gradients indefinitely. If corona is present, polyethylene – like all other conventional insulations – is gradually degraded. Corona must be minimized or avoided.

Q: Does corona produce a surface effect or an internal one?

A: A surface effect. In case of voids in the body of an insulation, corona appears only on the inside surface of the void.

Q: What are the implications of this study for the manufacturer and user of cables?

A: The importance of freedom from corona is highlighted – this means designing for the absence of either internal voids or space next to strand or shield. It is also important to design for an absolute minimum of residual mechanical strain, which would accentuate the effect of any residual or momentary corona. Improved life in nitrogen as compared with air suggests advantages for nitrogen or other gas pressure-type cables for the higher voltage levels.

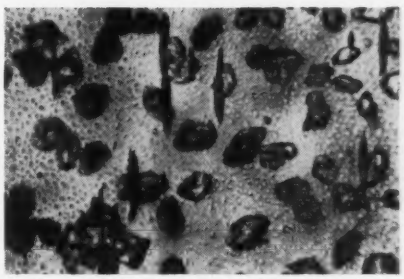
Du Pont does not manufacture wire and cable but supplies thermoplastic resins for insulation and jacketing.

by Joseph R. Perkins

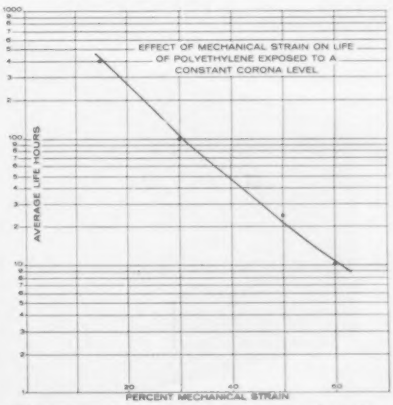
A detailed Du Pont research program on the behavior of polyethylene under high-voltage gradients has provided some interesting answers to two questions: What product information must be supplied to the cable designer to enable him to design the best high-voltage cable? How can Du Pont devise and manufacture the best polyethylene for this use?

Experiments involving more than 400,000 sample exposure hours have demonstrated the ability of polyethylene to withstand high voltage, the effects of corona and mechanical strain, entirely unexpected effects of humidity, behavior under inert gases and the relative importance of many other variables.

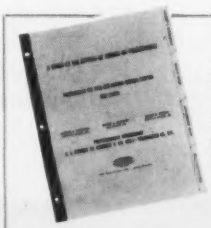
Also revealed was the fact that Du Pont ALATHON 3B polyethylene resin is the best resin among those tested for use as a primary power-cable insulation. It proved superior to all other commercially available resins examined under all conditions tested: air at 50% and 95% RH and inert atmospheres.



Highly magnified view (250x) of a stretched polyethylene surface after exposure to corona. The cracks run at right angles to the direction of stretching; the crystals are oxalic acid.



Effect of mechanical strain on life of polyethylene exposed to a constant corona level.



SEND FOR YOUR FREE COPY of this 28-page illustrated booklet: "A Study of the Effects of Corona on Polyethylene". It will give you full details of all experimental results and the techniques by which they were obtained. Write to: Polychemicals Dept., Room 176, E. I. du Pont de Nemours & Co. (Inc.), Wilmington 98, Delaware.

POLYCHEMICALS DEPARTMENT

DU PONT

REG. U. S. PAT. OFF.

Better Things for Better Living . . . *through Chemistry*

ALATHON® POLYETHYLENE RESINS | RULAN® FLAME-RETARDANT PLASTICS | ZYTEL® NYLON RESINS

Question:

How does Duquesne Light Company approach the problem of locating 23 kv substations in closely built-up residential areas?

Answer:

By using completely metalclad substations with S&C metal enclosed fused load interrupter switchgear developed cooperatively by Duquesne and S&C; and by putting the 23 kv and 4 kv circuits underground (as shown at right).

3-bay S&C switchgear unit for primary of Duquesne Light Company substation.

Q: Why is S&C metal enclosed fused load interrupter switchgear suited to substations in closely built-up residential, commercial, and industrial areas?

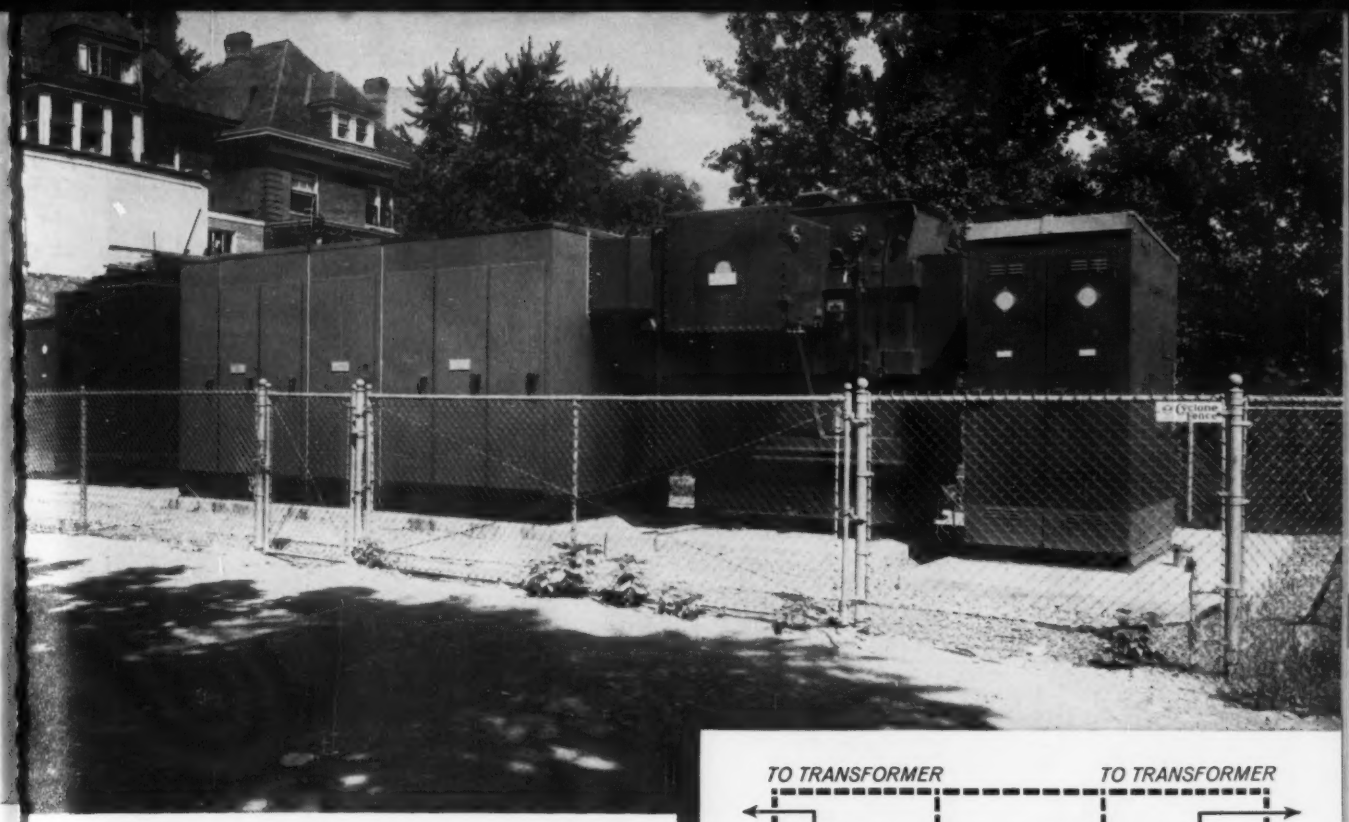
A: Because it gives safety to the public, attractive appearance, and compactness.

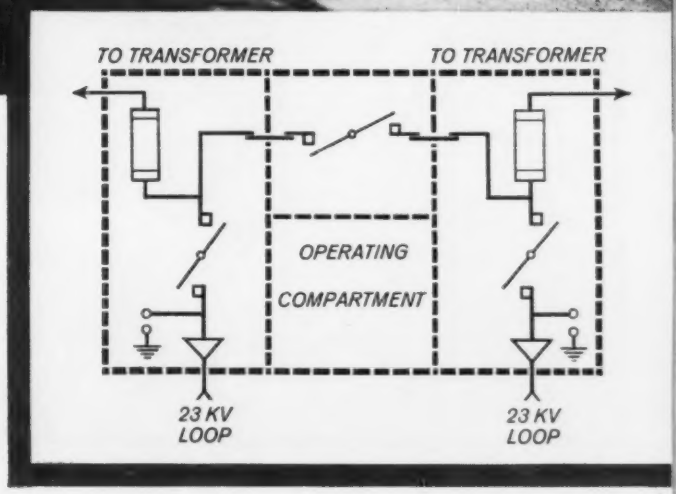
Q: How is attractive appearance achieved?

A: By eliminating steel structures or wood poles, exposed switches, potheads, fuses, and lightning arresters. This gear is also streamlined so that a Duquesne substation offers a low silhouette which fits unobtrusively into its surroundings.

S&C

Specialists in High-Voltage Circuit Interruption





Q: What does compactness mean to Duquesne?

A: Large sites are not required for these substations, thus the difficulty of site procurement, not to mention the cost, is significantly reduced.

Q: Why was S&C chosen to participate with Duquesne in this cooperative program to develop a completely metal-enclosed 23 kv substation?

A: Because S&C had developed compact load interrupters for arc-free switching, as well as a correspondingly compact power fuse with controlled exhaust—both ideally suitable for metalcladding.

Q: How can utilities learn more about the use of S&C metal-enclosed fused load interrupter switchgear?

A: Write for additional information to S&C Electric Company, 4421 Ravenswood Avenue, Chicago 40, Illinois. In Canada: S&C Electric Canada, Ltd., 8 Vansco Road, Toronto 18, Ont.

S&C METALCLAD FUSED LOAD INTERRUPTER SWITCHGEAR

Citric Acid -- Dowell's New Service for Cleaning Stainless Steel Process Equipment

Now, for the first time, plant operators can be sure of a new degree of safety in the cleaning of their pressure units containing austenitic stainless steel—for example, heat exchangers, stainless-clad pressure vessels, atomic reactors, and supercritical-pressure steam generators. Citric Acid service by Dowell provides a new, effective method for these special chemical cleaning situations.

The Citric Acid used in Dowell chemical cleaning is inhibited with an *exclusive chloride-free* inhibitor. Cleaning with this new field-proven solution assures a chloride-free solvent system, and thus helps prevent chloride stress-corrosion cracking.

Dowell Citric Acid also provides other significant advantages: Citric Acid stabilizes dissolved iron and helps prevent precipitation of insoluble iron compounds when neutralizing chemicals are used. Flushing of the unit is not as difficult when Citric Acid is used. Citric Acid is especially suitable where stainless steel and other metals are used together in construction of the unit.

Citric Acid cleaning with a chloride-free inhibitor is just one of the new ideas from Dowell research. Other recent contributions include the new "white glove" standards of cleanness, copper removal agents and the new jetting device for cleaning heat exchanger tube bundles.

Ask your Dowell representative about Citric Acid service and Dowell chemical cleaning programs for your plant equipment. Dowell, the leader in chemical cleaning service and research, operates in every major industrial area through 165 offices and stations. Dowell, Tulsa 1, Oklahoma.

Chemical cleaning service for all industry

DOWELL

DIVISION OF THE DOW CHEMICAL COMPANY

A secondary capacitor for *lowest* installed cost per kilovar

Sangamo Secovar 240 volt secondary capacitors are installed at the customer's service to give maximum system benefits all down the line. This new addition combines a 2 kvar capacitor with a meter socket. When used in new construction or when re-wiring, the only installation cost involved is that which would normally be required for a meter socket.

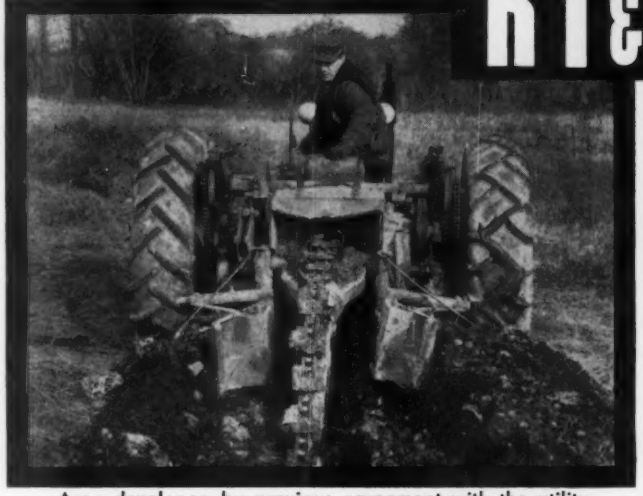
Sangamo's exclusive Secovar Capacitors are available in three types to meet your requirements: The new Type OS (Original Socket) 2 kvar rating; Type S, a 2 kvar rating for socket mounting; and Type N, a 1 or 3 kvar rating for nipple mounting. All types are fused and some models can be furnished with a Klixon thermostatic switch if desired.

For details, consult your Sangamo Representative, or write for Bulletin 1132.

SANGAMO ELECTRIC COMPANY
Springfield, Illinois

PC59-3

RT&E Terra-Trau

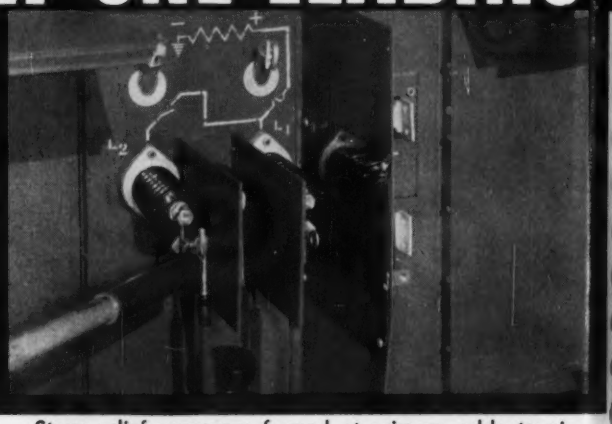


Area developer, by previous agreement with the utility, does trenching and pouring of concrete at his expense. Utility and developer cooperate in establishing final grade, so that uniform cable depth can be maintained.

Conduit bends for primary cable are positioned at transformer site. After ducts for both primary and secondary cable are laid, the trench at pad location is back-filled, and loose earth is tamped.

SHOW HOW ONE LEADING

When homes are ready for service, transformer is brought to pad location and bolted to the pad by means of the studs set in the concrete.



Stress relief cones are formed at primary cable terminations. Connections to transformer bushings are made by means of hot line clamps designed for either hand or hot stick operation.

UNDERGROUND DISTRIBUTION

Terra-Trau ready for service. All that remains to be done is the connection of customer-owned secondary and final landscaping, to be completed as shown in this illustration.

INSTALLATION PHOTOGRAPHS

Wooden form for transformer pad is constructed at transformer site and concrete is poured. Both of these jobs are the responsibility of the area developer.

Direct burial primary and secondary cable is laid in trench and terminations brought out at transformer site.

UTILITY HOLDS DOWN

Lineman demonstrates method of removing or inserting bayonet-type high voltage fuse or disconnect switch that is used when energizing or de-energizing the Terra-Tran.

Secondary connections are made to complete the installation. Terra-Tran's green finish blends in with surroundings.

SYSTEM COSTS

RT&E

ENGINEERING TALENT CONCENTRATED ON ONE IDEA
A BETTER TRANSFORMER

CORPORATION
WAUKESHA, WISCONSIN
PORTLAND, OREGON

DD

Distribution engineer says:

"Reynolds 5005 proves ideal for reconductoring– easy to string–easy to splice"

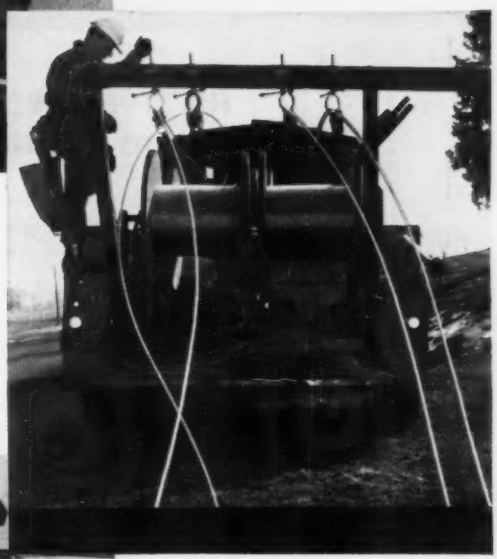
"Installation costs were reduced and we expect lower maintenance cost on this job," adds the engineer of a Midwest utility who recently designed Reynolds new all-aluminum conductor into 12.5 KV distribution line.

Many major utilities are finding 5005 an excellent conductor buy from four important cost stimdpoints: (1) *Lower original cost.* 5005 is lower in price than copper or equivalent ACSR. (2) *Lower installation costs.* 5005 is easy to string, easy to handle. And because it has no steel core, it's simple to splice. (3) *Lower maintenance costs.* 5005 is a high strength alloy—stronger than EC—resists rough treatment and abrasion. 5005 has no steel core which means no galvanic corrosion, and because this utility practices "hot line" maintenance on their distribution lines, the elimination of the steel core greatly simplifies splicing operations. (4) *Better scrap value.* If and when this line is scrapped, the all-aluminum 5005 will bring higher value.

Reynolds Cables made of 5005 aluminum alloy have properties and sag characteristics that make them especially attractive.The new conductor has met a specific need for relatively short span construction . . . it is also ideal as the neutral messenger in triplex and has many interesting possibilities in the larger sizes. Investigate the potentials 5005 may have for you. Complete electrical, physical and mechanical data is available. You may obtain it by contacting your Reynolds branch office, your Reynolds Electrical Distributor, or by writing *Reynolds Metals Company, P.O. Box 2346-EL, Richmond 18, Va.*

The Finest Products Made with Aluminum are made with REYNOLDS ALUMINUM

"Splicing is simple with 5005 —no steel core—we use standard connectors and standard tools," says the line foreman of this installation.

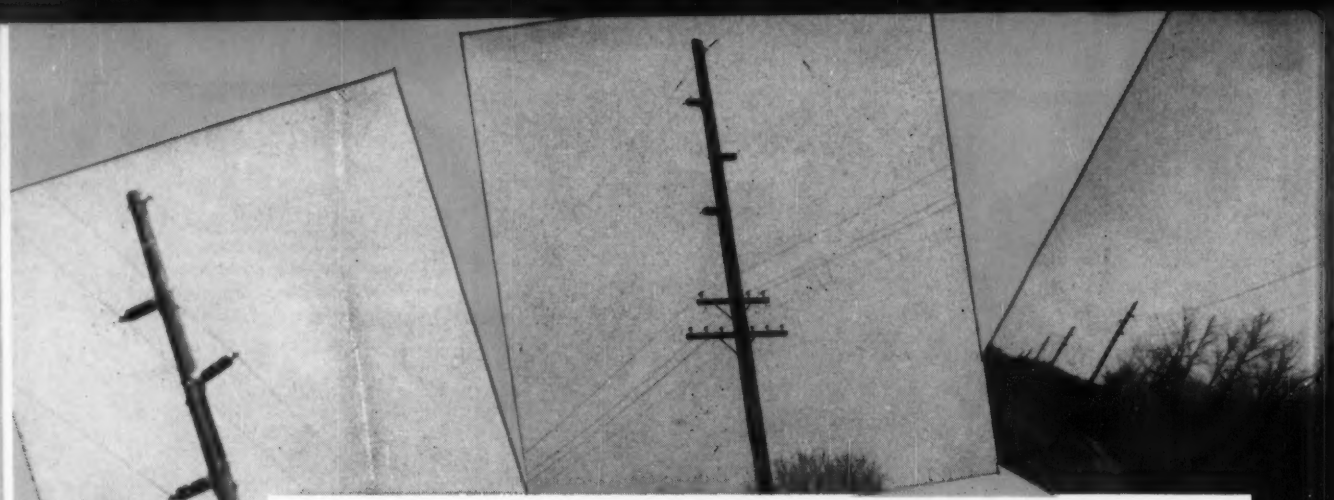


Reynolds 5005 being reeled off for stringing. Linemen like the way the all-aluminum conductor handles . . . it is light in weight and being a high strength alloy it resists rough treatment and abrasion.

Reynolds engineering on the job. Reynolds Electrical Conductors Director, Harold Adams, (on truck) inspects the 5005 cable and the reel setup with utility and contractor personnel.

REYNOLDS ALUMINUM

Watch Reynolds TV show—"WALT DISNEY PRESENTS"—every week on ABC-TV.



THE STORY OF "LOW-COST" CONSTRUCTION THAT TURNED OUT TO BE THE "HIGH-PERFORMANCE" LINE DESIGN

Almost from the introduction of the Lapp Line Post, adventurous distribution and transmission engineers started experimenting with lines on which conductors were carried on Line Posts horizontally mounted and bolted directly to wood poles.

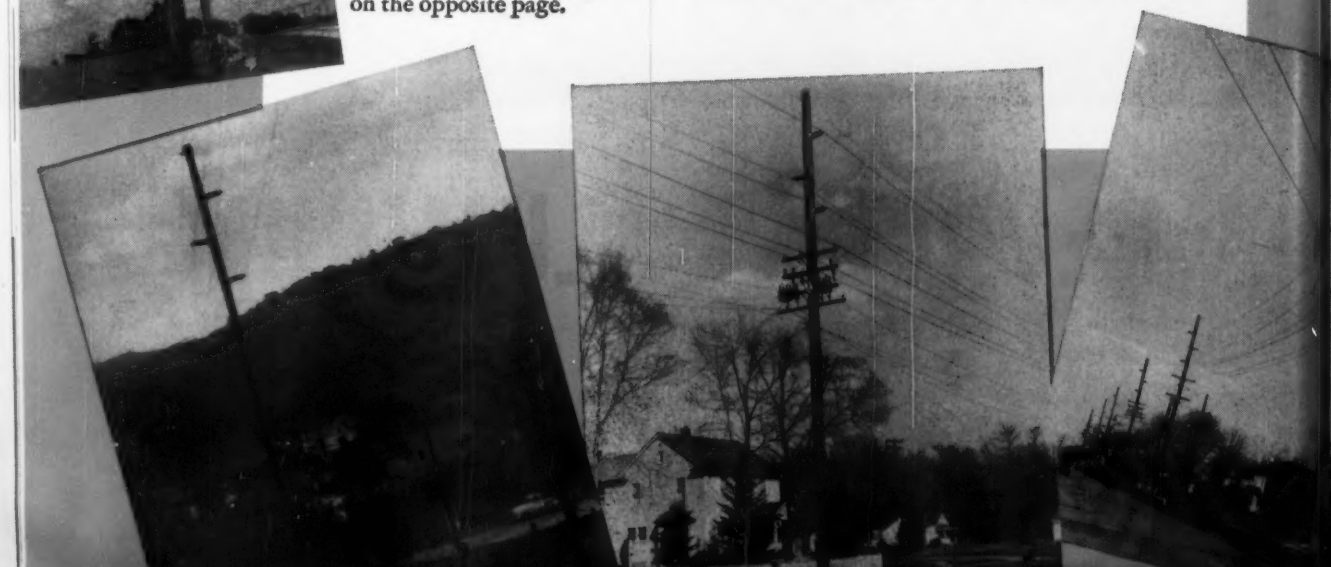
Nobody could question the *economy* of such construction. About a 25% saving in labor. And, of course, elimination of cost for a lot of crossarms, bracing and hardware. Made an unobtrusive, trim-looking line, too. And certainly a line requiring the narrowest right-of-way you could dream up.

Well, through the years a number of such lines have gone into service, at voltages 13.2 kv to 69 kv, a few of which are shown in snap-shots here. Some of these lines now have been in service for more than 20 years. And, as we've already hinted in the headline to this piece, the service records they've built have been simply remarkable. More than one utility official has told us "the only completely trouble-free line we've ever operated."

There are sound reasons why this should be so, understandable in terms of Lapp Line Post characteristics. In the first place, it's a sturdy one-piece porcelain body, with its hardware attached externally, to impose only large-area low-intensity compression forces on the porcelain. It is the one line insulator mechanically suited to horizontal mounting.

But it's in electrical characteristics that horizontal mounting makes Line Posts shine! Wet flashover values are increased by as much as 15% over upright ratings . . . because more insulator surface is exposed, wetting is more uniform. Natural cleaning is better in wind and rain, too; dry shadow areas are eliminated, reducing incidence of pole fires and contamination flashovers.

We've been encouraged . . . in fact pursued . . . to do something to get this sort of construction standardized. What we've done we're glad to tell you about . . . on the opposite page.

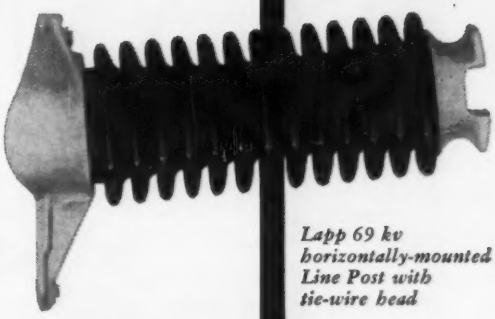


Entire structure is easily assembled on the ground before erection

Lapp 69 kv horizontally-mounted Line Post with trunnion conductor clamp

and now...

LAPP LINE POSTS SPECIFICALLY DESIGNED FOR HORIZONTAL MOUNTING



Lapp 69 kv horizontally-mounted Line Post with tie-wire head

A new series of Lapp Line Posts for horizontal mounting is now offered in six voltage ratings: 35 kv, 45 kv, 55 kv, 66 kv, and 88 kv. The bases are malleable iron castings with a mounting radius which will provide maximum contact to Class 1, 2 and 3 poles. Insulators are bolted directly to the pole by bolts at top and bottom of the base. This design provides that full cantilever strength of the insulator be developed with little deflection, and without failure of pole or mounting bolts. (Compare this with typical crossarm construction, where failure of braces or splitting of crossarm would occur at a value far less than the 2800 lbs. for which the insulator is rated.) In addition, longitudinal loading is possible at a value at least 50% more than can be withstood by crossarms. This extra strength permits use of longer span lengths, larger conductors and greater factors of safety.

By use of a simple outrigger shield wire and ground wires, it is practical and economical to achieve a structure flashover value with horizontally-mounted Line Posts greater than that of a typical wood-crossarm wood-brace vertical insulator assembly . . . with no possibility of wood burning or splitting. This is explained in Lapp Data Sheet No. 539, a copy of which is yours for the asking.

Lapp

LAPP INSULATOR CO., INC., LE ROY, N. Y.

"Why all the fuss about new types of motor insulation? We don't have trouble!"

Users of Elliott large induction motors have enjoyed unequalled freedom from insulation troubles, thanks to FABRI-SEAL insulation. Introduced ten years ago, this system has established an unparalleled record of continuous service.

ELLIOTT
Fabri-Seal
INSULATION

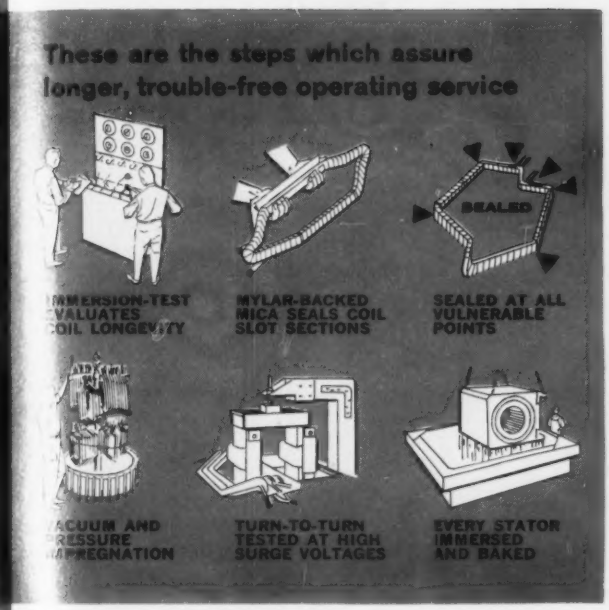
How Elliott Fabri-Seal chalked up amazing ten-year record

FABRI-SEAL was first introduced in 1948. Since then Elliott has installed FABRI-SEAL coil insulation in over 2,000,000 hp of large squirrel-cage induction motors. The result has been unprecedented.

Today, more than 10 years after the first FABRI-SEAL insulation system was installed, operating failure has occurred at only one installation. Investigation disclosed that this breakdown was in no way due to weakness in the FABRI-SEAL system.

As illustrated here, FABRI-SEAL includes the sealing of stator coil slot sections with hand-wrapped Mylar*-backed mica wrappers, plastic-sealing at all vulnerable points, vacuum pre-conditioning and pressure impregnation to remove air and moisture, turn-to-turn testing at high surge voltages, immersion of the complete stator in special, flexible insulating varnish and subsequent baking. Rigidly-controlled fabricating procedures assure optimum protection in the finished coil.

*Dupont Trademark


These are the steps which assure longer, trouble-free operating service
SEALED
MYLAR-BACKED MICA SEALS COIL SLOT SECTIONS
SEALED AT ALL VULNERABLE POINTS
TURN-TO-TURN TESTED AT HIGH SURGE VOLTAGES
EVERY STATOR IMMERSED AND BAKED

However, even though motors having FABRI-SEAL insulation continue to chalk up unmatched records, Elliott persistently continues its research. In the last two years, Elliott has "life-tested" hundreds of sample coils, systematically selecting and testing almost every conceivable combination of materials.

Consequently, today Elliott is installing a new and much superior FABRI-SEAL in all of its large induction motors for applications requiring Class A and Class B insulation.

The most significant step in the production of this new FABRI-SEAL is the outside sealing of the completely insulated coil and all coil connections with a special sealing layer in combination with other compatible sealing materials. Accelerated life-testing in the laboratory indicates that the advanced FABRI-SEAL will withstand immersion in water at least five times longer than the original.

For applications requiring class H insulation, Elliott offers Fabri-Lastic— a silicone elastomer material with all "mechanical bugs" removed*

Elliott engineers early recognized the advantages of silicone elastomer* as a moisture barrier. Careful research, however, revealed an alarming number of inherent mechanical weaknesses. To solve these inadequacies, Elliott engineers set out to find the right combination of silicone elastomer and compatible materials which would provide the mechanical stability to withstand operating stresses normally found in applications requiring Class H insulation.

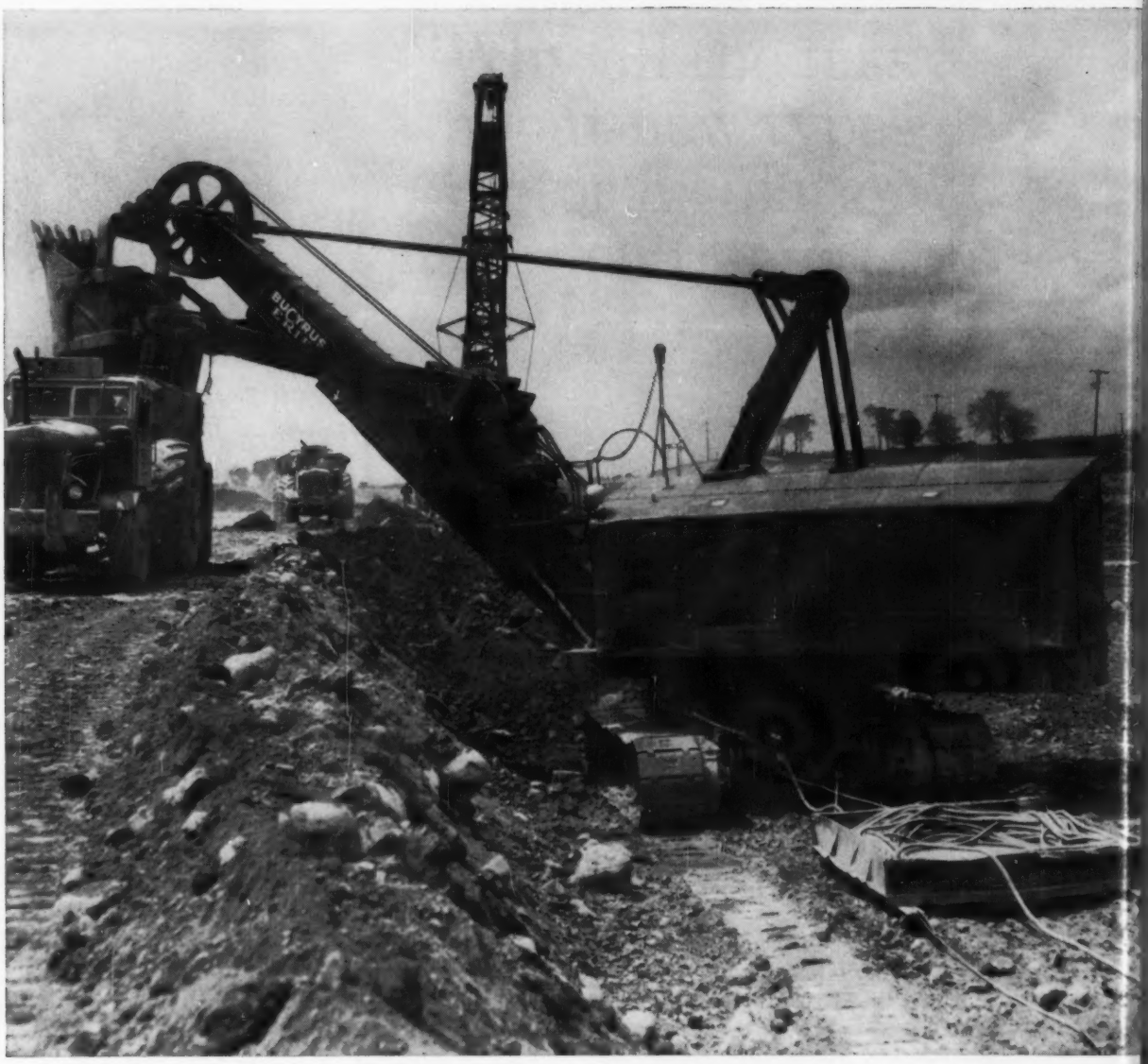
Once again Elliott research paid off. After several years of intensive experimentation and testing involving hundreds of sample coils—*the first really mechanically-adequate silicone insulation system*—FABRI-LASTIC—was completed. Basically, the new FABRI-LASTIC system consists of the skillful processing of glass-supported silicone elastomer which is vulcanized into a void-free homogeneous structure. The result: rugged mechanical and dependable sealing properties.

Benefits—in addition to flexibility and moisture protection—are outstanding durability and toughness as well as excellent thermal stability at high temperatures. Extensive lab-testing of FABRI-LASTIC indicates superior coil and lead protection from moisture, dust, dirt, oil, acids and other contaminants. In addition, protection is provided against leaks, reversion, etc., which have plagued other systems. And FABRI-LASTIC assures freedom from cracking, pull-through or shear at pressure points.

Obviously, the end result is greatly extended motor life.

**Commonly called rubber*

ELLIOTT Company
RIDGWAY PLANT RIDGWAY, PENNSYLVANIA



USS Tiger Brand Amerclad Cables are built tough and strong to withstand dragging over sharp rocks, and exposure to sun, rain, grease and oil.

Right—Strength and flexibility of Amerclad are shown by its use over this cable bridge leading to a power shovel.

Far right—Vibration resistance of the Amerclad Cable is the main reason for its use on this railroad track tamping machine.

USS **Tiger Brand Electrical Wire & Cable**

A standard cable for every special job

- Asbestos Wire and Cable
- Mold-Cured Portable Cord
- Shovel & Dredge Cable
- Paper & Lead Cable
- Varnished Cambric Cable
- Interlocked Armor Cable
- Special Purpose Wire & Cable
- Aerial, Underground and Submarine Cable

What's the difference in electrical wire and cable?

Even though electrical cables may look alike and start with some of the same materials, there's a *real difference* in the completed cables.

The difference in USS Tiger Brand Amerclad Cables results from a combination of research, engineering and construction. The development of better materials goes on constantly at American Steel & Wire. Insulation and jacketing compounds have been improved.

Better stranding designs and methods of stranding add years to cable life.

Amerclad Cables are protected by an outer jacket of Amerprene, an oil resistant compound containing a high percentage of Neoprene. Before being vulcanized, an Amerclad Cable is encased in a substantial lead sheath that is afterward removed. The pressure developed within this rigid mold during the vulcanization process produces a dense, non-porous jacket that is highly resistant to abrasive wear.

Knowledge of severe field conditions obtained through sales engineers permits designing for special conditions.

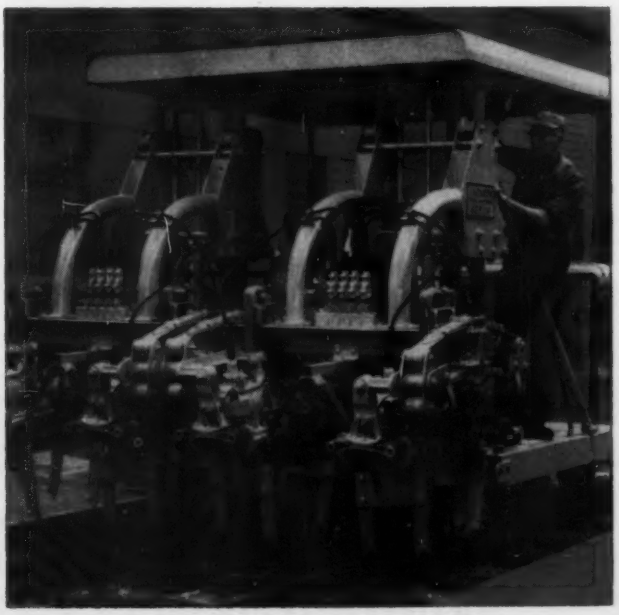
Constant effort to control quality and improved methods of inspection assure a product of highest quality.

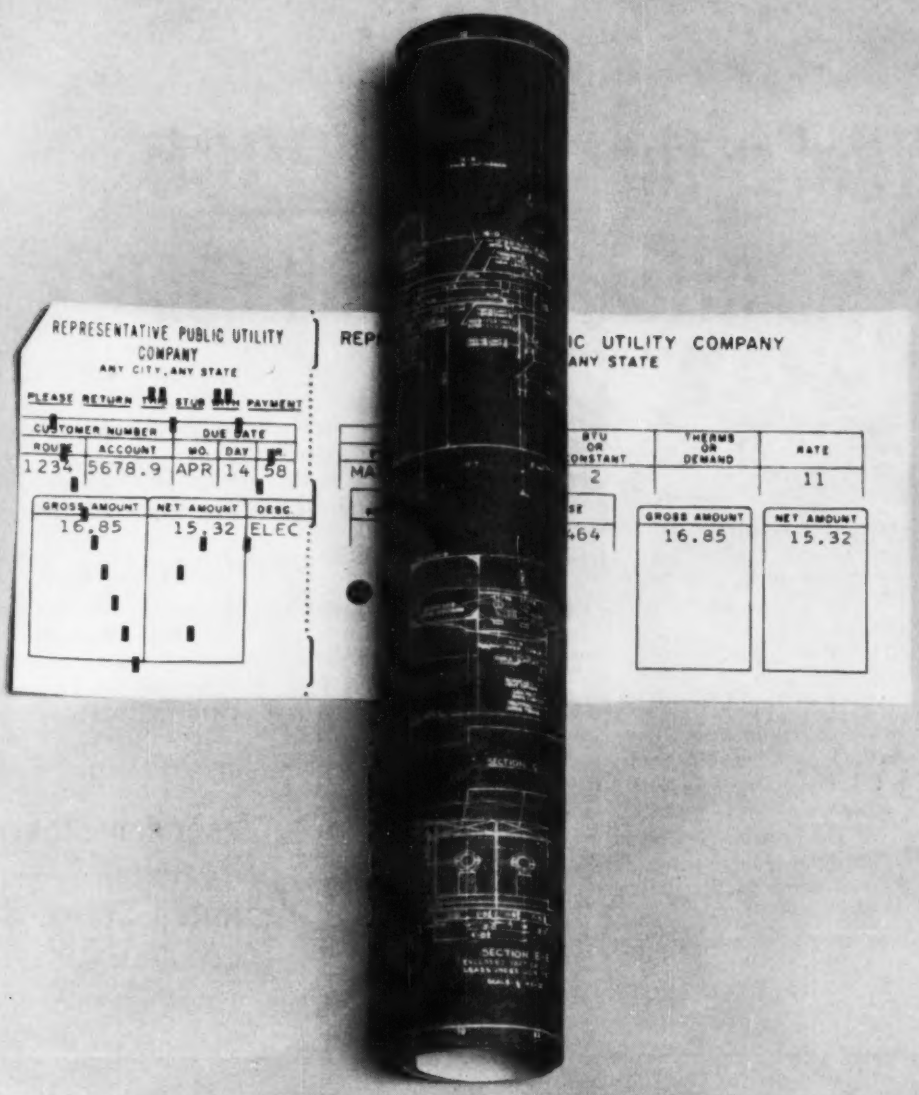
These are a few of the unseen plus values you get when you buy Tiger Brand Amerclad Cables for your shovels, dredges, continuous miners, drills, shuttle cars and other equipment. For complete technical information, write for our free book, "Tiger Brand Amerclad Cord Cable," American Steel & Wire, Room 9162, 614 Superior Ave., N.W., Cleveland 13, Ohio.

USS, Tiger Brand and Amerclad are registered trademarks

American Steel & Wire Division of United States Steel

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
Tennessee Coal & Iron Division, Fairfield, Ala., Southern Distributors
United States Steel Export Company, Distributors Abroad





ACCOUNTING PLUS ENGINEERING

One IBM System serves both

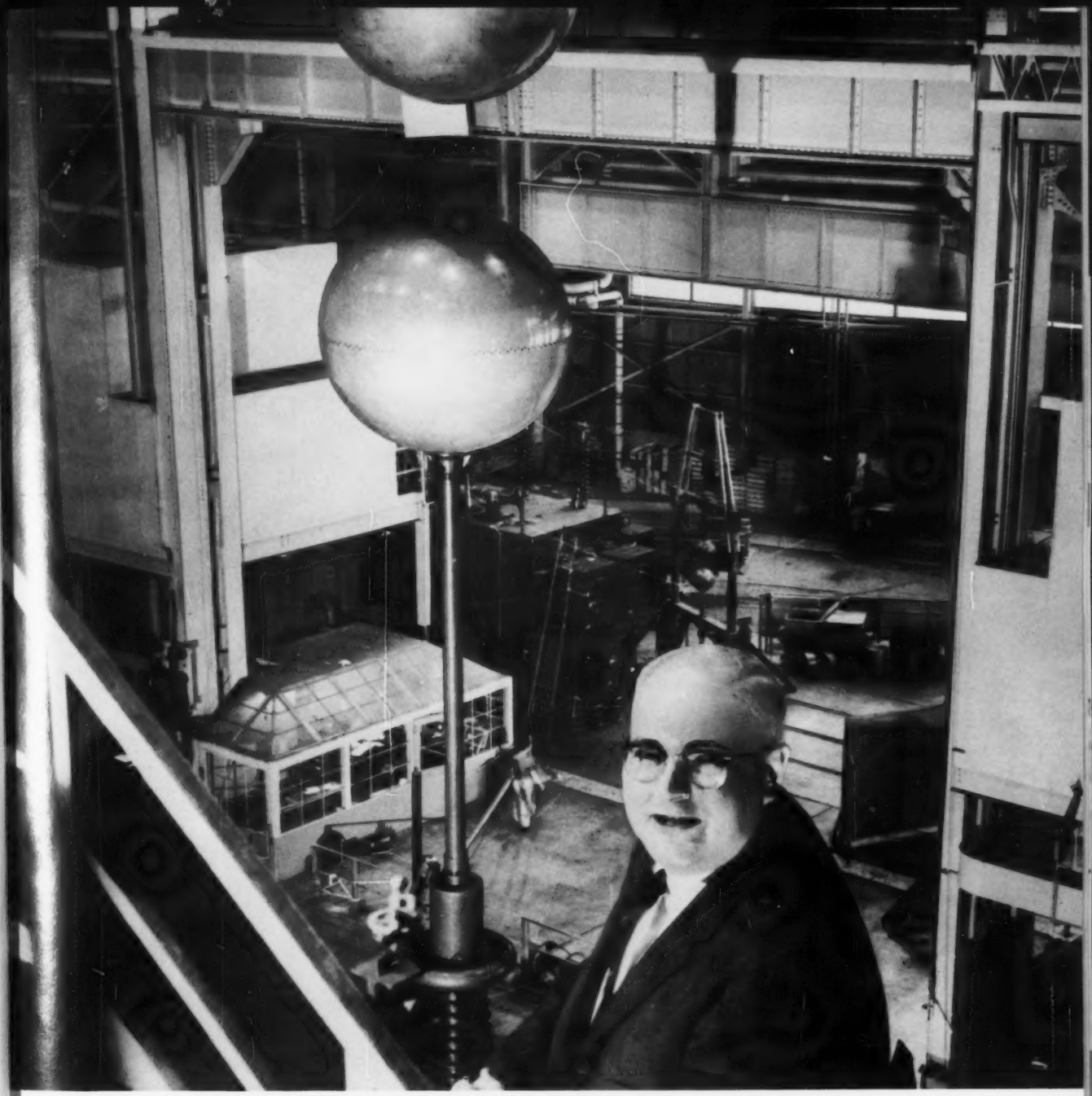
With the new flexible IBM 7070, data processing operations, **from engineering calculations to customer billing,** can be handled faster and more efficiently than ever before.

Engineering: The IBM 7070 is valuable in solving the many complex problems of systems planning, design and operations. Pipe stress analysis, heat rate calculations, load-flow studies, short circuit calculations, voltage profiles, capacitor placement studies, and distribution transformer-load management represent some of the problems that can be solved quickly on the general-purpose IBM 7070.

Billing and Accounting: Your entire customer master file can be processed and reviewed daily. This means . . . a complete billing cycle is balanced every day; all cash can be balanced and posted to the master file daily; final or special bills can be computed and prepared daily; consolidated listings are current and accounts receivable information is complete.

Fully transistorized, the IBM 7070 has larger storage capacity, faster internal processing, high-speed, high-density tape, and modular design that expands with the growth of your business. The 7070, like all IBM Data Processing equipment, may be purchased or leased. For the facts, call your local IBM representative.

IBM®



Mr. John C. Rissinger, Sales Manager, Power Transformer Department, in test center where Westinghouse studies today the problems which electric utilities will face tomorrow.

ELECTRIC UTILITY SAVINGS CREATED HERE

Giant research test center creates dollar-saving transformer Bonus Values

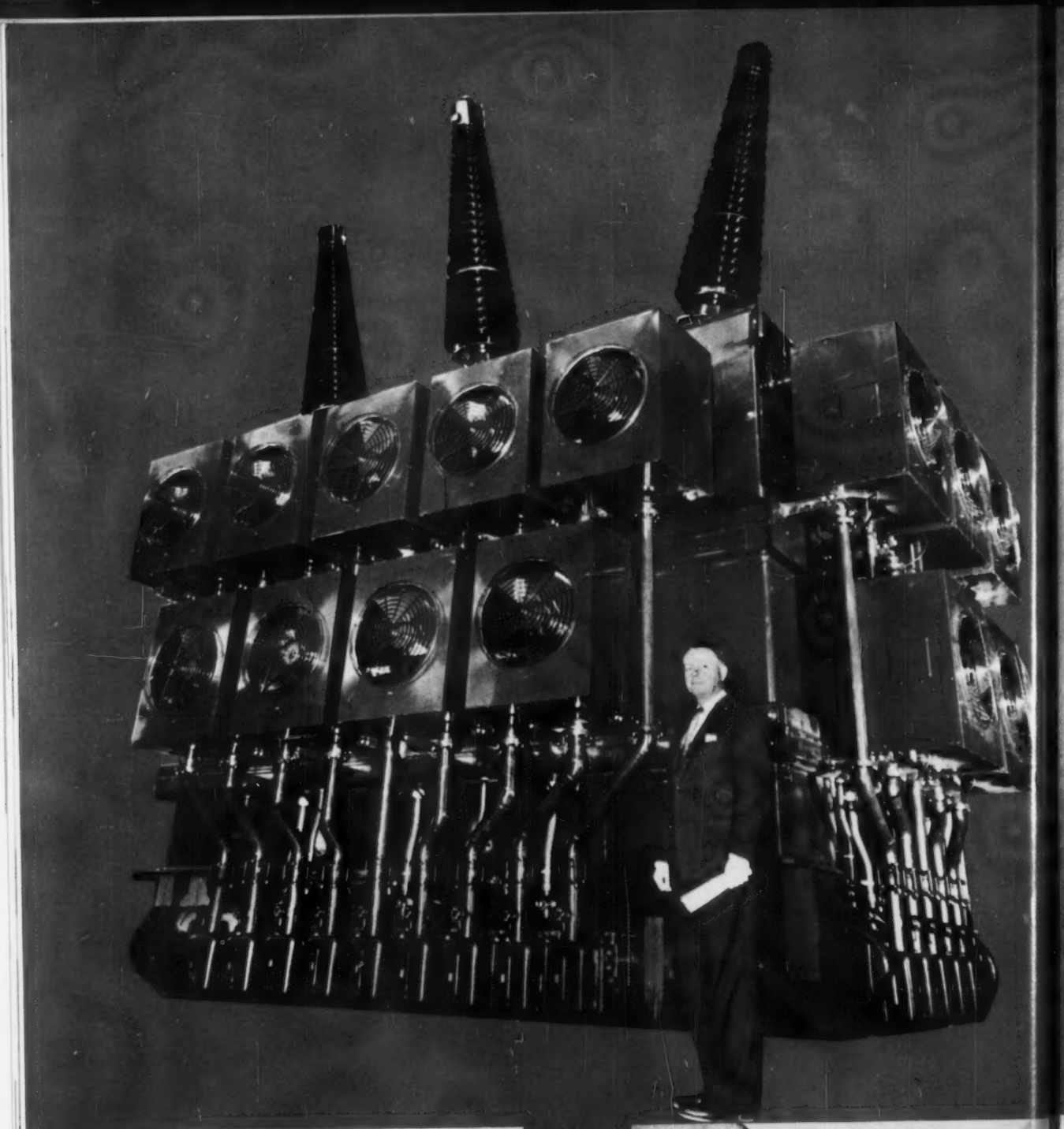
America's tremendous electrical growth has generated many problems for the country's electric utilities . . . problems of handling larger blocks of power, achieving more economical transmission, maintaining customer good will.

The Westinghouse Power Transformer Department is proud of its contributions toward helping utilities meet their current and long-range problems. From the research facilities at Sharon have come developments that have brought the industry installation, maintenance, operating and performance savings. These are the actual dollar benefits—the Bonus Values—found in new developments from the Westinghouse Power Transformer Department. These developments have been made possible through Westinghouse Plowback of Earnings into research and development.

YOU CAN BE **SURE**...IF IT'S

Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS"
CBS TV MONDAYS



The Insuldur system knows no bounds, as pointed out here by Mr. M. E. Fagan, Manager, Westinghouse Power Transformer Engineering Department, shown with a 345-kv, 275,000-kva, 3-phase Westinghouse power transformer with Insuldur insulation system.

INSULDUR SYSTEM ADDS 10% EXTRA OVERLOAD CAPABILITY... SAFELY!

Another exclusive Westinghouse Bonus Value created by Plowback of Earnings

The exclusive Insuldur* system now used in all Westinghouse power transformers beats the heat—retards deterioration of transformer insulation. The Insuldur system utilizes an amine stabilizing compound which gives insulation the ability to withstand higher temperatures . . . safely.

No matter what your present overload practice, the Insuldur-protected Westinghouse transformer can carry 10% more overload than any other transformer built . . . with no additional loss of insulation life.

Here is your means of allowing more overload—and obtaining more revenue—economically . . . and safely. For example, if you can economically justify overloading an ordinary transformer 125% for 24 hours, an Insuldur-protected transformer can be overloaded 135% for the same time—with no extra loss of insulation life.

The exclusive Insuldur system now protects all Westinghouse power transformers —large power, substation, network, CSP® power and mobile substations.

Ask your Westinghouse representative about the Insuldur-system protection for all power transformers. He can show you the "Crumble Test"— dramatic proof of added insulation strength.

*Trade-Mark

The "Crumble Test" shows superior heat-aging resistance of exclusive Westinghouse Insuldur-system insulation . . . proves that overload conditions endanger the life of ordinary insulation. During overload tests, ordinary insulation has charred, crumbled and "died", Insuldur-system insulation has bounced back . . . stayed "alive" . . . providing safe, extra overload capacity.

FOR LOW-COST REGULATION:

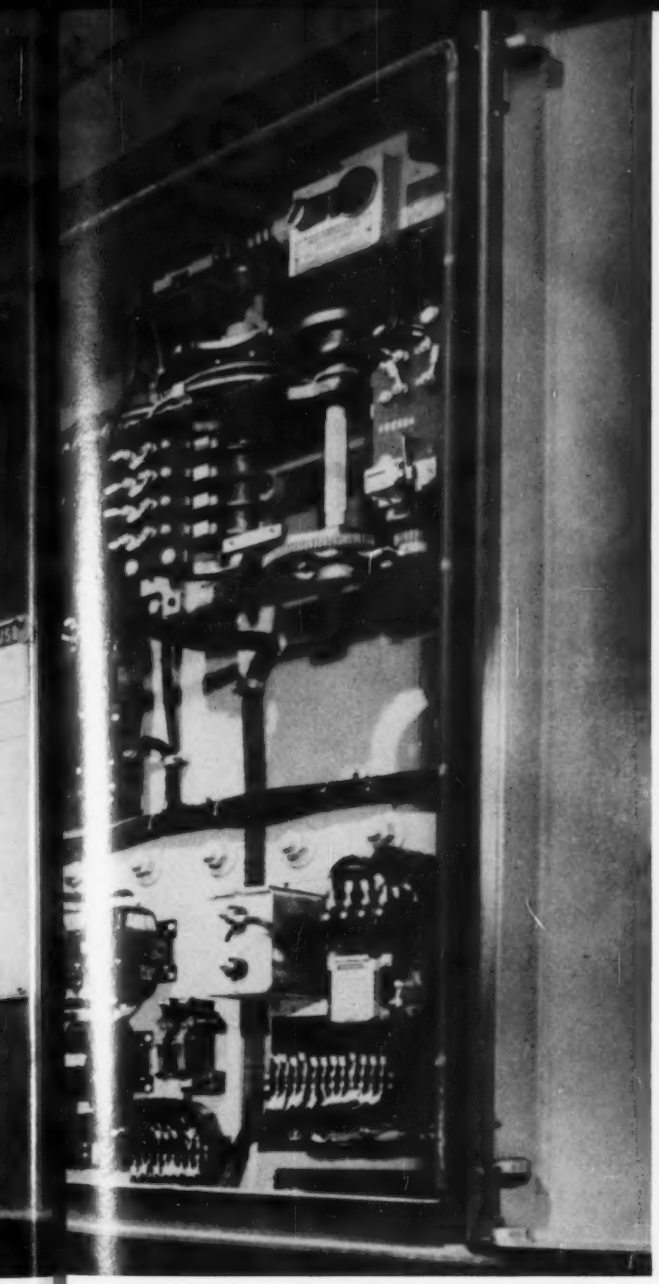
Since the introduction of Magamp control just three years ago, over 1200 units have been supplied for load tap changing equipment placed in service by electric utilities. Today, these Magamp units continue to deliver trouble-free performance after a total of over 83,000,000 tap changer operations.

Magamp means trouble-free, maintenance-free service under all conditions when used on a station-type voltage regulator, an LTC transformer or a CSP power transformer.

Magamp control is completely static. There are no moving parts to clean and adjust, no contacts to check and burnish, no relays to be rebalanced. Magamp control settings are all electrical . . . and the "set-and-forget" control never needs adjustment.

The Westinghouse load tap changer is another important factor in providing low-cost regulation, with minimum maintenance. Its direct-drive Geneva gear mechanism assures optimum speed of moving contacts to prevent burning. It provides shockless acceleration and deceleration, has been tested to eight million operations with no appreciable wear. This means extra years of contact life.

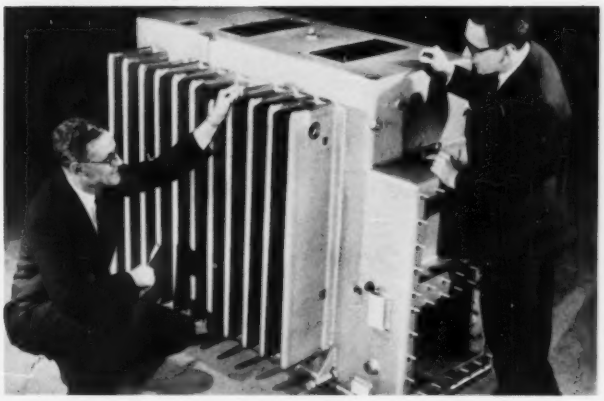
Westinghouse offers an exclusive 20-year prorated warranty on contact life for URS tap changers—regardless of the number of operations.



Maintenance-free Magamp control and 20-year minimum tap changer contact life

Ask your Westinghouse representative to show you how Magamp control and the direct-drive tap changer combine to improve your power distribution economics, with reduced regulation and maintenance costs . . . a double dollar-saving Bonus Value made possible by Westinghouse Plowback of Earnings into a continuing program of research and development.

Mr. Don Ralsten, Westinghouse sales engineer, and Mr. John Harrell, Manager, Westinghouse Network and Regulator Sales, review the moneysaving advantages of Magamp control in this LTC substation transformer on the system of a progressive midwestern utility.



Mr. J. C. Gardner (left), Westinghouse network transformer sales, and Mr. G. A. Monito, network transformer engineering, discuss the improved tank construction of the new Westinghouse universal design network transformer.

NEW SPACE-MISER NETWORK TRANSFORMER ADDS FLEXIBILITY, CUTS MAINTENANCE

New Westinghouse universal design for Space-Miser network transformers can be used in either vault or subway applications. This single design replaces the two designs formerly necessary. Stocking is now greatly simplified; a utility which has had to maintain stocks of spare units for both applications now can stock only units of this universal design, and inventories can often be substantially reduced.

Save on maintenance, too . . . The coolers are now made of heavy copper-bearing steel. This new design provides better protection against corrosion. The number of welds has been reduced by 30%; the welds in the cooler area are made by an automatic welder, giving smoother, more uniform welds which permit better paint adhesion, better protection in these critical areas.

The new Westinghouse Space-Miser with universal design retains all of the advantages of the standard Space-Miser construction—small size, round-cornered tank and Yukon coolers.

Ask your Westinghouse representative for the full story of the new universal design network transformer—available in ratings of 300, 500, 750 and 1000 kva at 5, 15, 25 and 34.5 kv.

YOU CAN BE SURE...IF IT'S Westinghouse

YOU CAN BE SURE... IF IT'S
Westinghouse
Westinghou

In photo at left, T. A. Kraft (right), Budget and Application Engineer, Ohio Edison Company, with Westinghouse representative S. S. Waters, as they analyze a spec for one of the new features of the redesigned Westinghouse substation transformer. Below, Messrs. Kraft and Waters at installation site of the new, streamlined Westinghouse unit now in service at Ohio Edison's McKnight Substation in Akron.

IMPROVED APPEARANCE, LOWER SOUND LEVELS BUILD BETTER CUSTOMER RELATIONS

...''Better Neighbor'' Bonus Values created from Westinghouse earnings reinvested in development. This new line of Westinghouse substation transformers meets the electric utilities' needs for more attractive, quieter transformers to be located in residential areas. Streamlined and uncluttered, these new units will reduce complaints of unsightliness from your customers. Here's how appearance has been improved:

- Rounded-corner tank permits better paint adhesion and coverage, stops ugly corrosion before it starts.
- Elimination of external braces takes away other sources of corrosion, prevents debris trapping.
- Randomly scattered gauges and valves have been relocated in a weatherproof enclosure conveniently placed at eye level.

This all adds up to better appearance, better customer relations . . . and because many possible target areas for corrosion have been eliminated, these new transformers will reduce maintenance costs, too.

The lower sound levels of these new substation transformers are another step toward better customer relations, are expected to reduce the "noise" complaints of your customers. In many cases, there will be a direct dollar-saving benefit to utilities—no costly sound dampening barriers and enclosures.

Your Westinghouse representative will be happy to tell you the full story of this new line of streamlined, quieter substation transformers.

HOW WESTINGHOUSE IS SAVING ELECTRIC UTILITIES MILLIONS OF DOLLARS...

These seven Bonus Values, created through the years by Westinghouse, continually save millions of dollars in installation, maintenance and operating costs:

- **Reduced Sound Levels**—Westinghouse power transformer sound level reduction—saves up to $17,000 on original cost.
- **Inner-Cooled Construction**—Space and weight reduced up to 15%, with lower impedances and improved performance.
- **Vapor Cooling**—Westinghouse V/g transformers combine dry-type safety with the capacity and BIL of liquid-filled units.
- **"Form-Fit" Construction**—Westinghouse power transformer construction has for years been outstanding for high mechanical and dielectric strength.
- **Shipping by Schnabel Car**—Extra "room to grow" for future transformers; even supervoltage transformers can be shipped in one piece.
- **Standardized Condenser Bushings**—Westinghouse bushings set industry standards for fifty years needed no design change to meet new ASA standards
- **Forced-Oil Cooling**—Another Westinghouse pioneered concept, forced-oil cooling has saved electric utilities over $100,000,000.

These and other developments created by Westinghouse research continue to provide the equipment to meet America's growing power needs—economically.

JI-7090

YOU CAN BE SURE...IF IT'S Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS"
CBS TV MONDAYS

ANSONIA

Ankoseal®

Quality

POWER AND CONTROL CABLES

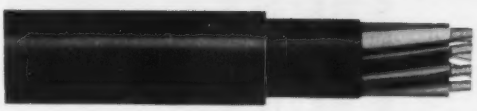
In The Finest Modern Plastics Insulations and Jackets

From the largest plant devoted entirely to the production of plastic cables come:

0-1000V CONTROL CABLE

Stranded conductors are flexible, insulated with polyethylene. Nylon jacket over insulation provides extra protection. Mylar tape over cabled conductors, polyvinyl chloride jacket.

0-1000V STATION CONTROL CABLE



Polyethylene insulated conductors, S. I. C. rating (2.39) and power factor rating (.0003) remain constant at high frequency and under wet conditions. Mylar tape over cabled conductors, polyvinyl chloride jacket overall.

SUPERVISORY CONTROL CABLE

Polyethylene or polyvinyl chloride insulation. Polyethylene or polyvinyl chloride jacket. With or without shielding. Color coded to I. P. C. A. specifications or as desired. Alpeth constructions to REA #22 and #23 specifications and composite types with twisted pairs available.

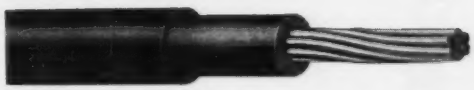
STREET LIGHTING CABLE

Direct burial, or overhead thermoplastic insulated and jacketed cables. Highly resistant to earth, acids and alkalies, moisture, sunlight and weather. Insulation either polyethylene or polyvinyl chloride. Shielded types available.

POLE AND BRACKET CABLE

Designed for street lamp base or overhead circuit to lighting fixture. Polyvinyl chloride installation polyethylene jacket. Low voltage operation between conductors — high voltage from conductors to ground.

CATHODIC PROTECTION CABLE



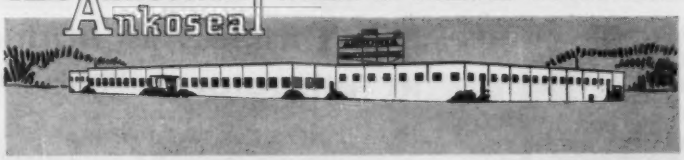
Insulated with polyethylene jacketed with polyvinyl chloride or special polyethylene. Highly resistant to most acids, alkalies and chemicals common in corrosive soil areas.

POWER CABLE 0-5000 VOLTS

Polyethylene insulated. Semi conducting tape over and under insulation. Metallic shielding tape and polyvinyl chloride jacket.

Ask for Ansonia Ankoseal Brochures on Supervisory and Station Control Cables — Street Lighting Cables.

THE ANSONIA WIRE & CABLE COMPANY

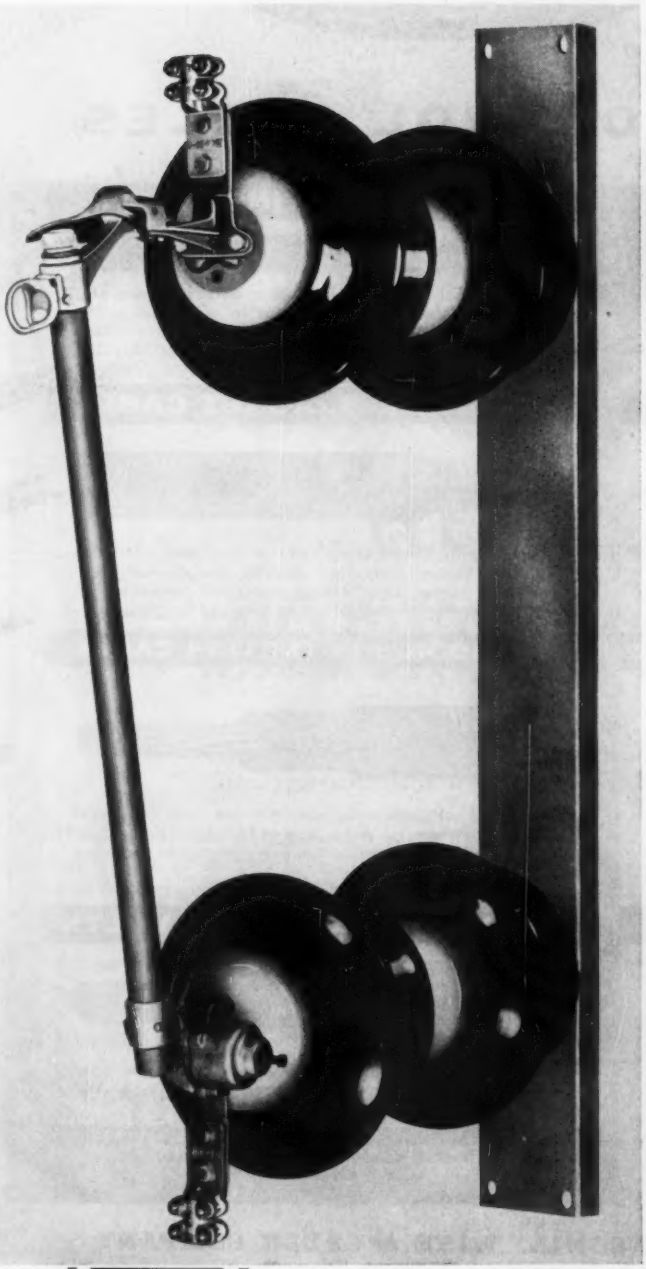


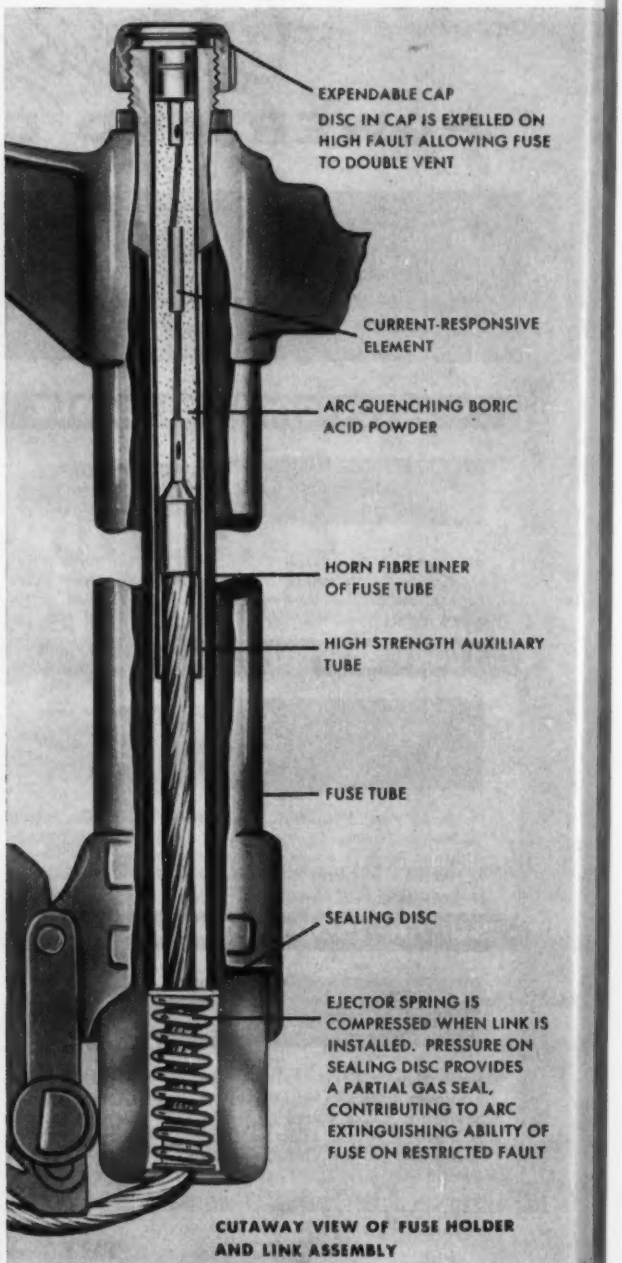
111 MARTIN STREET, ASHTON 12, RHODE ISLAND

"Leadership In Plastic Cables Through Quality and Service"

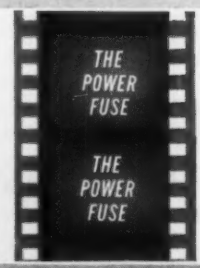
194-9

A Reliable New Family of F




EXPENDABLE CAP
DISC IN CAP IS EXPELLED ON HIGH FAULT ALLOWING FUSE TO DOUBLE VENT
CURRENT-RESPONSIVE ELEMENT
ARC-QUENCHING BORIC ACID POWDER
HORN FIBRE LINER OF FUSE TUBE
HIGH STRENGTH AUXILIARY TUBE
FUSE TUBE
SEALING DISC
EJECTOR SPRING IS COMPRESSED WHEN LINK IS INSTALLED. PRESSURE ON SEALING DISC PROVIDES A PARTIAL GAS SEAL, CONTRIBUTING TO ARC EXTINGUISHING ABILITY OF FUSE ON RESTRICTED FAULT

CUTAWAY VIEW OF FUSE HOLDER AND LINK ASSEMBLY



Don't miss this sound movie in full color..."The Power Fuse"

It is available, without cost, for viewing by anyone interested in power fuses. On-the-spot results of field tests conducted in conjunction with a leading utility. Factual, informative, well worth your time. Contact your Southern States representative to arrange a showing, or write direct to the company.

Power Fuses by Southern States

- POSITIVE CLEARANCE OF RESTRICTED FAULTS
- HIGHEST INTERRUPTING RATINGS AVAILABLE
- WIDEST RANGE OF SELECTION
- SIMPLIFIED CONSTRUCTION

Reliable performance—to provide dependable protection against high or low fault currents—is one of the most important requirements demanded of power fuses by engineers. With this uppermost in mind, we developed our new family of power fuses.

Extra reliability in clearing restricted faults is provided by the new, dual-operating characteristics of the expendable cap and arc-quenching boric-acid fuse link.

Extra reliability in handling high faults is provided by the double-venting action, fibreglass tubes and other design features—resulting in interrupting ratings approaching 3½-million kva at 161 kv.

A wider range of selection permits adequate fusing without buying excessive interrupting capacity.

The expendable cap and the sealing disc at the lower end of the fuse prevent the entrance of moisture or extraneous matter. Patented electrostatic shielding eliminates corona damage. A built-in snubber brings the fuse holder to a cushioned, shock-free stop. All in all, this rugged new family of power fuses is engineered to provide completely reliable service for many years.

Get the full story from your Southern States representatives, or write for Bulletin 59PF.

RE-FUSING IN THE FIELD IS QUICK WITH SOUTHERN STATES FUSE KITS

Economical fuse kits, with all of the components necessary for re-fusing in the field, are available for all Southern States Power Fuses. Four speed ratios—clearly marked, compact packages.

PIONEERS IN POWER FUSES SINCE 1924

SS **SOUTHERN STATES** EQUIPMENT CORP.
HAMPTON, GEORGIA

IN CANADA: Dominion Cutout Co., Ltd., Toronto

TREND OF DISTRIBUTION TRANSFORMER LOSSES
PERCENT
100
90
80
70
60
50
40
30
20
10
1925
1930
1935
1940
1945
1950
1955
1960
COPPER LOSS
INDUSTRY STANDARD
STANDARD TRANSFORMER
CORE LOSS
EXCITING CURRENT
10
Standard

THE RESPONSE OF PEOPLE IN THE FIELD

"Peak up here comes in December when ambient temperature drops to zero and stays there. By using a Standard SWA we can install a 25 KVA unit where we used to install 37.5 KVA units. In this way we have the lower core loss of a 25 KVA unit the year 'round plus the advantage of excellent regulation and lower copper loss under peak load conditions with plenty of thermal capacity to carry our peak."

Northern Plains State Engineer

"Glad to hear that someone has developed a distribution transformer like the SWA that cuts down on our service complaints when temperatures hit 110° in August. With 3 HP single-phase motors on air conditioning units, the improved regulation of the SWA is the feature we like. The low losses give us better thermal capacity."

Southwest Utility

"We buy at primary rates. We have to pay for losses. The extremely low losses (far below industry standards) of the SWA series enable us to drastically reduce unaccounted for KWH."

REA Manager

"At the time of system peak our distribution transformers are hitting their peak. Distribution transformer losses represent 3.5% of our system peak. The low copper losses of the SWA cut our system peak. With the present rise in cost of capacity, this is very important to us."

Mid-west Utility Engineer

"As I study the performance data on the SWA, it seems to me it's the greatest advance in distribution transformer design since grain-oriented steel."

Major Eastern Utility Executive

The Standard Transformer SWA distribution transformer reduces copper losses up to 30%; reduces impedance; improves regulation and increases thermal capacity.

The SWA does do all that we've claimed. But don't take our word for it. Here are three practical steps to prove to yourself what the SWA can do on YOUR DISTRIBUTION SYSTEM:

BULLETIN S-401-C will be sent by return mail at your request. It gives all performance data and shows you how to relate the SWA's dramatic reduction of losses to your revenues.

ASK THE STANDARD REPRESENTATIVE to discuss the SWA and its cost-saving features with your engineering staff. He can give them operating facts as they relate to your particular peak load problems.

PUT THE SWA ON TEST in your system or in your test lab. Measure the losses. See how MUCH BELOW industry standards the SWA losses are.

The SWA can increase your revenues. Take a look. Prove it to yourself.

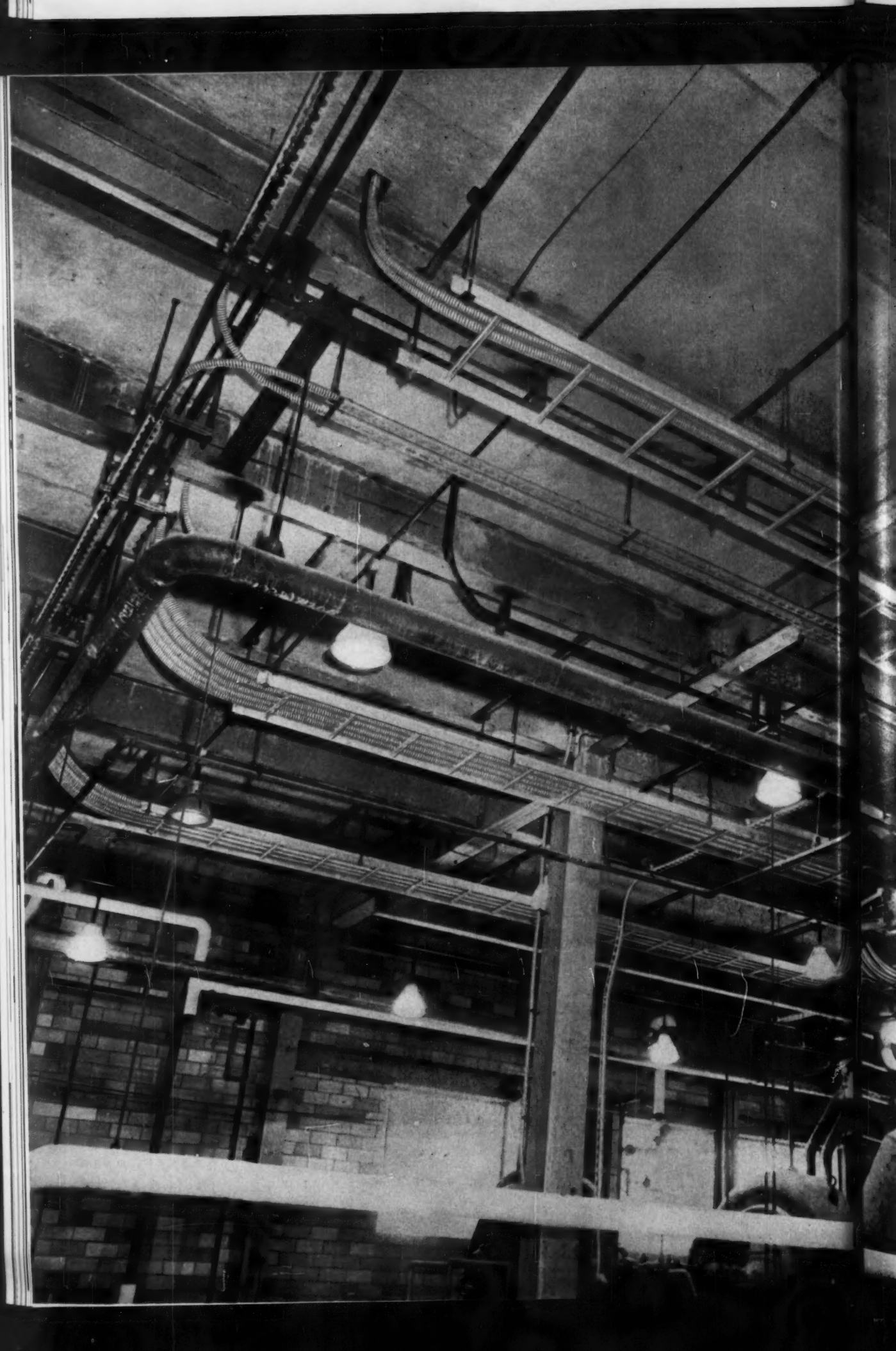
Phone WARREN
EXpress 2-1563

40 years of concentration on transformer design exclusively

Standard Transformer CO.

WARREN, OHIO

"WHEREVER THERE IS POWER"



this picture shows why . . .

Anaconda's Duralox Cable cuts installation costs for Electric Utilities

Duralox needs no conduit—saves time, money, man power . . . provides greater safety!

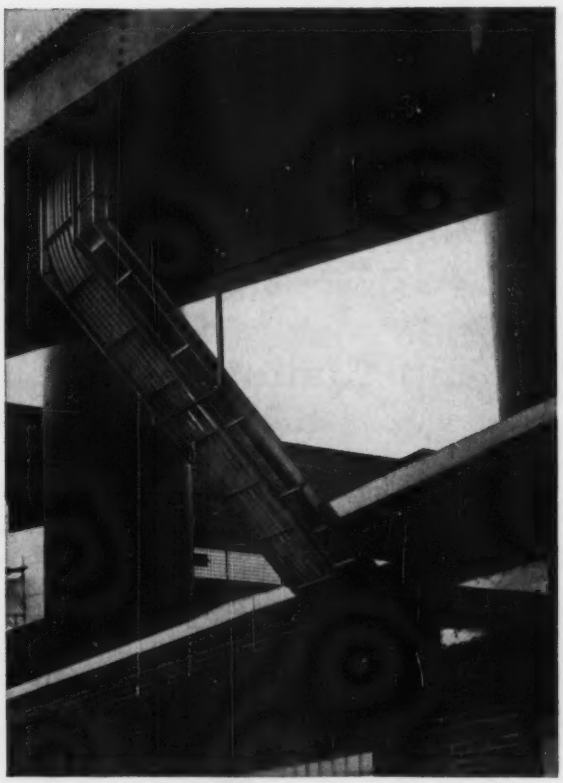
Duralox* is enclosed in its own durable, yet flexible metal armor. Thus, it can be installed *without* conduit—in long runs over and around obstructions, in racks, indoors or out. For one midwest utility this meant a savings of $5.00 per foot—over the cost of installing ordinary cable with rigid conduit!

Duralox is so flexible that additional flexible connections are not needed at motors. Duralox is easily moved—allowing for changes in design during construction or service, and facilitating repair work on other apparatus.

Because cables are always shielded, Duralox means greater safety.

And Duralox's lower reactance in higher voltages—from the close spacing of conductors—results in reduced voltage drop and more efficient power distribution. Anaconda Duralox Cable is available in all popular sizes and voltages—copper or aluminum conductors with paper, rubber, plastic or varnished-cloth insulation. Anaconda Duralox is also available for control circuits.

Why not talk to the Man from Anaconda about Duralox for your utility operation. See Anaconda in your telephone directory, in most principal cities.



FITTING NEATLY AROUND OBSTRUCTIONS. Anaconda Duralox Cable meant easy installation in utility's generating station.

BULLETIN DM5606 on Anaconda Duralox is yours for the asking. Write: Anaconda Wire & Cable Company, 25 Broadway, New York 4, N. Y.

*Reg. U.S. Pat. Off. 58307

OUTSIDE RUNS of weather-resistant Duralox are supported by simple extensions of racks. Since Duralox can be used inside or out, number of joints is kept to a minimum.

LIVE BETTER ELECTRICALLY

SEE THE MAN FROM

ANACONDA®

FOR **DURALOX POWER & CONTROL CABLE**

Ingersoll-Rand Steam Condenser Serves

AXIAL-EXHAUST turbine

at MECO's Portland Station

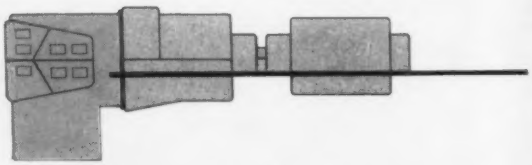
METROPOLITAN EDISON COMPANY'S new 165,000-kw Portland Station, designed and built by Gilbert Associates, Inc., features many advances in central station design—including the Ingersoll-Rand 80,000 sq. ft. surface condenser shown above.

To meet the unusual requirements of the axial-exhaust turbine and Monotube boiler, the condenser design incorporates the following features:

- Straight-through, horizontal steam path engineered for minimum friction and maximum pressure recovery . . . higher cycle efficiency.
- Reversible single-pass counter-flow cooling water circuit, convertible to two-pass operation.
- Hotwell storage of 16,000 gallons of deaerated condensate.
- Condenser is designed to receive steam by-passed from the Monotube boiler and features a built-in attemperating device.
- Welded tube ends prevent any possibility of feedwater contamination.

The Ingersoll-Rand condenser auxiliaries include circulating pumps, condensate pumps and air removal equipment consisting of two mechanical vacuum pumps with primary air-jet boosters. (Compressed air for soot-blowing and instrumentation is produced by Ingersoll-Rand compressors.)

For full details on this advanced condenser design, send for a copy of "The Condenser at Portland," Form 9306.



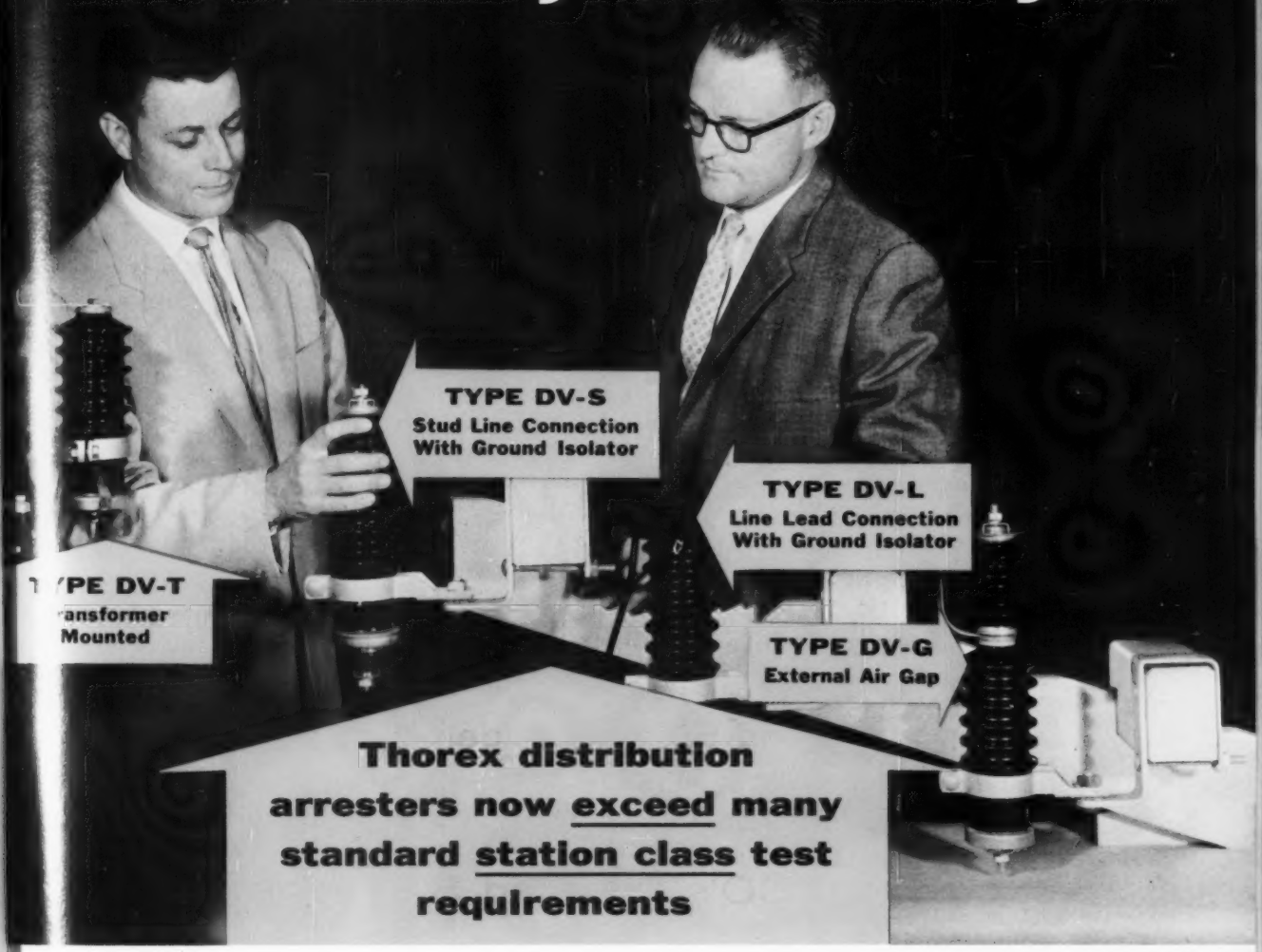
Simplified drawing of the Ingersoll-Rand 80,000 sq ft surface condenser connected to the axial exhaust turbine.

Ingersoll-Rand

4-952 11 Broadway, New York 4, N. Y.

COMPRESSORS • GAS & DIESEL ENGINES • PUMPS • AIR & ELECTRIC TOOLS • CONDENSERS • VACUUM EQUIPMENT • ROCK DRILLS

More than just variety...



Thorex distribution arresters now exceed many standard station class test requirements

Thorex distribution arresters go far beyond just meeting your preference with their variety of designs. These remarkably efficient protective devices exceed, by a wide margin, many present Standard test requirements of the heaviest duty Station Class. And all of this in a poletop arrester 10 to 50 per cent smaller than comparable models.

Possibly this best evaluates the remarkable advancement in the arrester art represented by the Dynagap. This same protective element is interchangeable in all Thorex ratings and classes - - hence the unheard-of performance of distribution grades.

For a degree of service and equipment protection totally new in distribution practice, at no cost premium, put Thorex Dynagap Type DV arresters on your system.

OHIO BRASS COMPANY, MANSFIELD, OHIO

Ohio Brass HOLAN

PORCELAIN INSULATORS · LINE HARDWARE · CAPACITORS · LIGHTNING ARRESTERS
BUSHINGS · HOLAN TRUCK-MOUNTED POWER DEVICES AND BODIES · BRONZE VALVES

4922-H4

Do you value
45 years' experience,
plus the industry's
best facilities are in these
O-B station posts

post experience?

The O-B station post is easy to get on any manufactured product- just ask for it!

Page 370 in our 1914 catalog (45 years ago) offered an O-B Station Post insulator. If you value long experience in the post business, here it is!

O-B Station Posts have since kept abreast or ahead of industry requirements. Today, the highly perfected design has features that are advantageous in many types of station construction: (A) Inherently high strength. (B) Great rigidity to assure proper gathering action of switches. (C) Long surface leakage length that is helpful in certain cases of air-borne contamination. (D) High resistance to lightning damage.

Switchgear and "packaged" substation manufacturers will gladly supply your choice of post insulators if you merely *express that choice.* Take advantage of the longest experience and best technical facilities in this branch of the industry. Ask your supplier for the O-B post. Name it, and you can have it!

OHIO BRASS COMPANY, MANSFIELD, OHIO

Ohio Brass

HOLAN

PORCELAIN INSULATORS · LINE HARDWARE · CAPACITORS · LIGHTNING ARRESTERS
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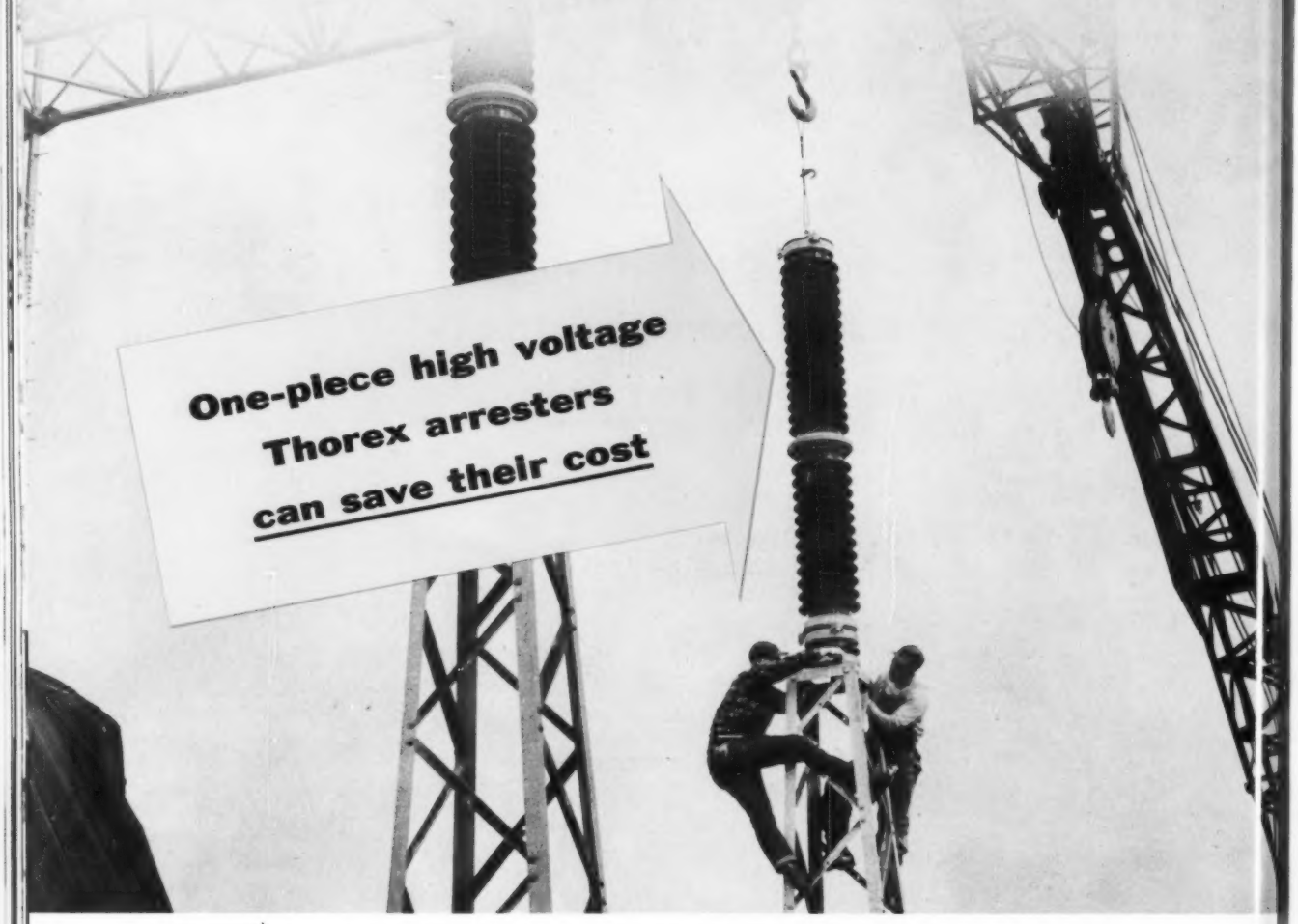
4922-H23

Convenience pays off



This Thorex Dynagap lightning arrester for 345-kv service arrived on the job in *one piece*. It was lifted directly from the packing case to its pedestal. Two or three minutes -- for only a couple of men -- and it was installed!

Compare this to what used to be the installed cost of high voltage arresters. Labor, special structures, added station area, often equaled the original purchase price.

And, for this sound bargain in lightning arresters, you get an entirely new order of surge durability and equipment protection, plus complete immunity from the effects of surface contamination. Thorex Type MPR arresters of any voltage can be hot-washed by hose or spray systems.

For the best of performance and -- by far -- the best installed price, put Thorex arresters in your new stations.

OHIO BRASS COMPANY, MANSFIELD, OHIO

Ohio Brass HOLAN

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BUSHINGS · HOLAN TRUCK-MOUNTED POWER DEVICES AND BODIES · BRONZE VALVES

4922-H1

call KE for plant expansion or new facilities

INGENUITY

STEEL

POWER

CHEMICAL

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Our most treasured ingredient at Kaiser Engineers is ingenuity. It manifests itself constantly in new, more efficient, and tested ways of designing and building our clients' plants.

Veteran KE engineers can take your facilities idea from a gleam in your eye through start-up. Or, they can perform any part of the project. One contract can cover all.

KE ingenuity—applied in fresh, daring ways since the start of contracting in 1914—can benefit your facilities. Investigate KE now!

has made KE a major engineer-contractor serving many industries

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economic analysis • plant location • engineering • design • procurement • expediting • construction

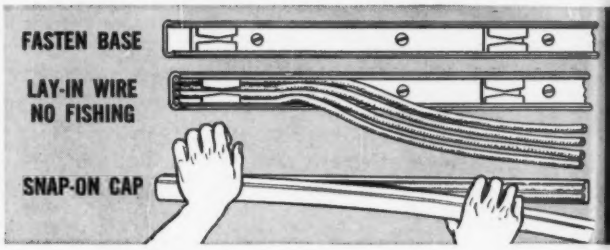
NATIONAL ELECTRIC NE DIVISION

New! Better! Best!

Line-to-load products with exclusive features plus flexibility

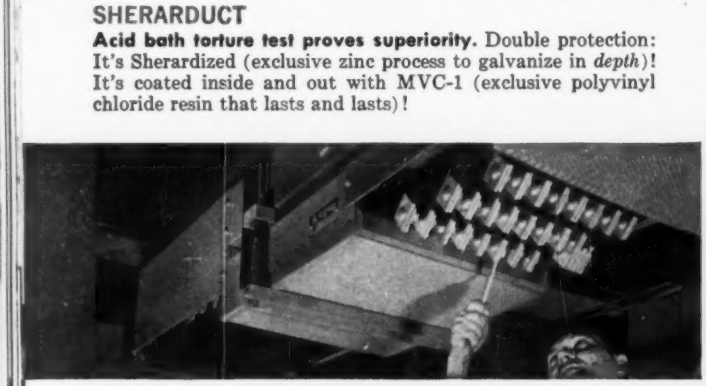
SHERARDUCT

Acid bath torture test proves superiority. Double protection: It's Sherardized (exclusive zinc process to galvanize in *depth*)! It's coated inside and out with MVC-1 (exclusive polyvinyl chloride resin that lasts and lasts)!



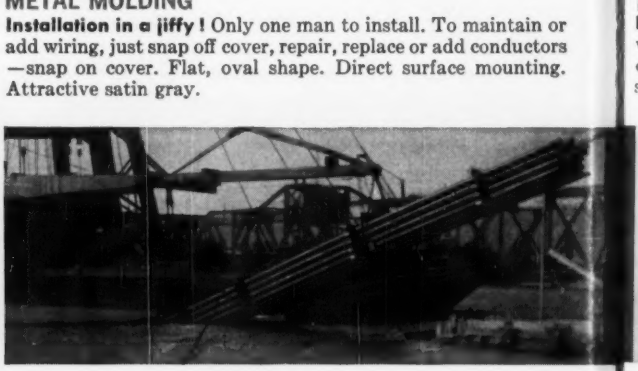
METAL MOLDING

Installation in a jiffy! Only one man to install. To maintain or add wiring, just snap off cover, repair, replace or add conductors —snap on cover. Flat, oval shape. Direct surface mounting. Attractive satin gray.



PLUG-IN AND LO-LOSS FEEDER BUSWAY

Lo-Loss busway has closely spaced bus bars for minimum voltage drop. Ratings to 4,000 amperes. Plug-in busway provides easy access to power along entire length of run. Ratings to 1500 amperes.



WROUGHT IRON CONDUIT

For corrosive areas. The only electrically-approved brand. Glass-like fibers in wrought iron create rust-impervious surface. Famous National Electric Sherardized *plus* MVC-1 vinyl coatings. Bends easily and uniformly.

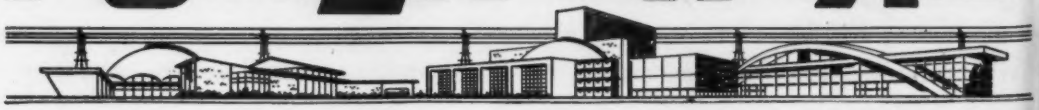
XDUCT JUNIOR

Quality control eliminates splits and high seams. E.M.T. with automated electronically-inspected production. Electrogalvanized outside surface. Aluminum enamel coating inside and out. Easy fishing. Superior bending. Silvery color.

PLUG-IN STRIP

Outlets every 6" or 18". Solid copper electrical system from panel box to last outlet. Lifetime receptacles. No screws, splices or weldpoints to become loose. For kitchens, workshops, offices, stores, laboratories and factories.

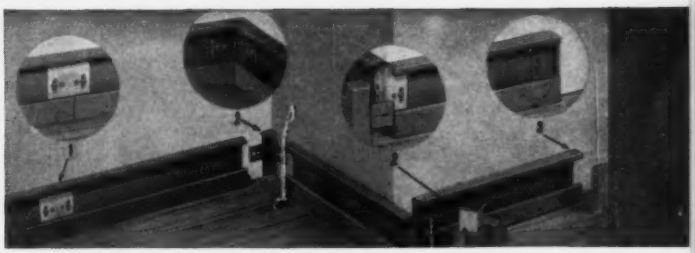
POWER AHEAD



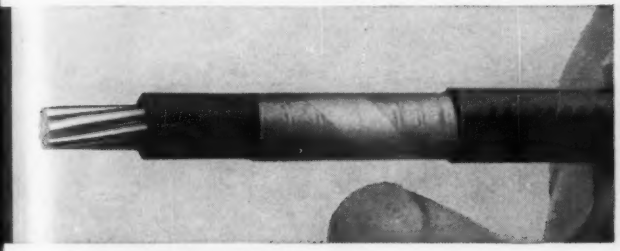
!from National Electric

ty and capacity potential to meet tomorrow's power needs today!

N W! 15,000 SERIES HEADERDUCT
Largest available capacity. A full 20.294 square inches of wiring area. Provides 100% accessibility to any or all cells in cellular steel floors. Handles largest phone cables. A complete system for cellular floor construction.

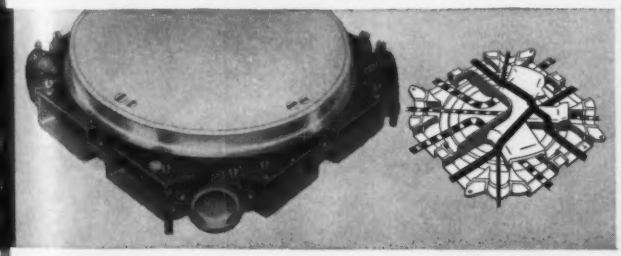


BASEDUCT
Saves up to 75% roughing time. Only 3 fittings needed, no screws, no welds. Multi-outlet surface raceway system for new or existing construction. Large, easy-access capacity for future wiring.

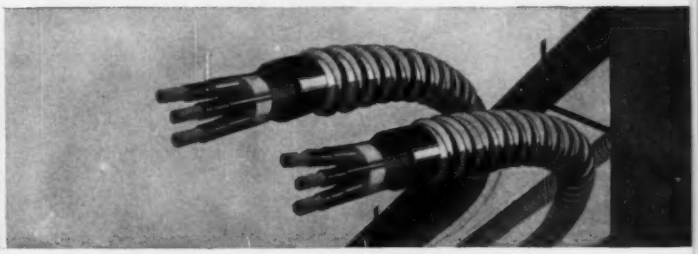


M .AR* TAPED BUILDING WIRE
Four times the abrasion resistance of rubber-filled tape. Highly resistant to flexing. High dielectric strength. Withstands action of acids, alkalies, moisture, and oxidation. Smaller diameter. *Dupont "Mylar".

TUFFCOTE TELEPHONE WIRE
Three times longer service than bare or low-insulation lines. Eliminates costly tree-trimming and noisy circuits caused by "grounding" in windy, wet weather. Exclusive thermoplastic insulated wire easily spliced to conventional wire.



NEPCODUCT
New junction box is quickly brought into alignment with finished floor even after concrete has set. Leveling adjustment can be made with screwdriver without removing cover plate. Lazy susan interior partition can be relocated in case box should be inadvertently installed in incorrect position.



NEPCO-LOK INTERLOCKED ARMORED CABLE
Outstanding flexibility cuts installation costs. Installed quickly around corners and projections. Economically relocated for changing power needs of the future. 600-5,000 or 15,000 volt . . . one, two, three or four conductor assemblies.

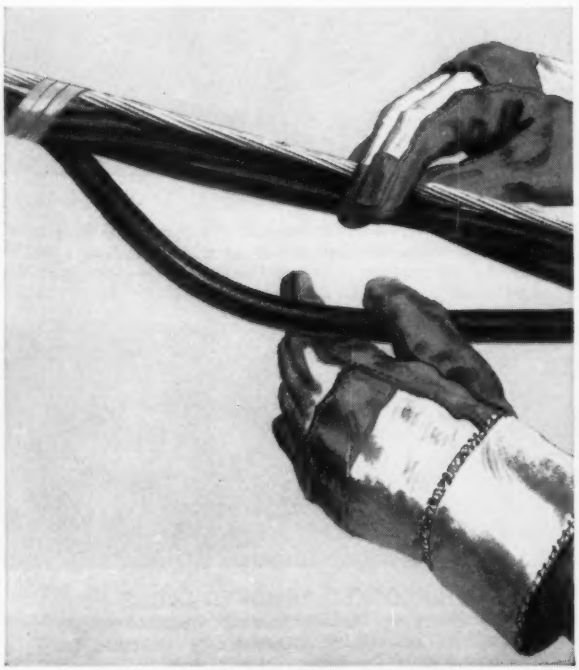
EXPERT APPLICATION ENGINEERING SERVICE AVAILABLE ON ALL PRODUCTS!

NATIONAL ELECTRIC DIVISION **PORTER** ***H.K.PORTER COMPANY, INC.***

PORTER SERVES INDUSTRY: with Rubber and Friction Products—THERMOID DIVISION; Electrical Equipment—DELTA-STAR ELECTRIC DIVISION, NATIONAL ELECTRIC DIVISION; Copper and Alloys—RIVERSIDE-ALLOY METAL DIVISION; Refractories—REFRACTORIES DIVISION; Electric Furnace Steel—CONNORS STEEL DIVISION, VULCAN-KIDD STEEL DIVISION; Fabricated Products—DISSTON DIVISION, FORGE AND FITTINGS DIVISION, LESCHEN WIRE ROPE DIVISION, MOULDINGS DIVISION; and in Canada, Refractories, "Disston" Tools, "Federal" Wires and Cables, "Nepcoduct" Systems—H. K. PORTER COMPANY (CANADA) LTD.

LIGHTWEIGHT KW ALUMINUM INITIALLY, CUTS

Costs 20% less than copper with equal current carrying capacity!



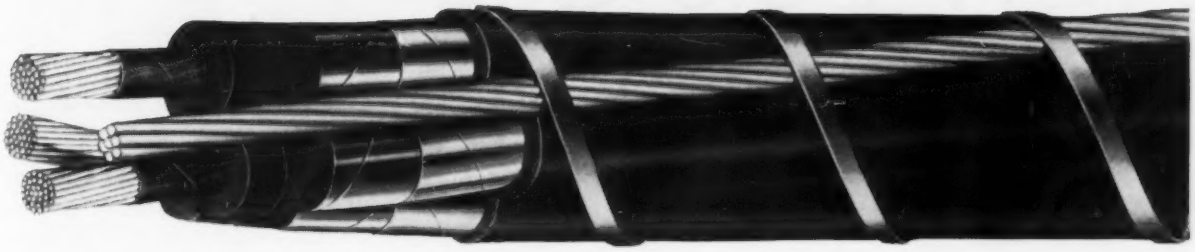
SIMPLE CONNECTIONS

Reverse lay provides simple and fast connections because the conductors can be easily separated to make taps and connections. Tapping can be accomplished quickly, safely and easily.

REDUCES TREE TRIMMING

Unlike open wire construction, compact preassembled KW aerial cable cuts tree trimming to a minimum, initially and periodically. Result: fewer service interruptions or outages during storms, less maintenance.

AERIAL CABLE COSTS LESS INSTALLATION COSTS



FASTER INSTALLATION

Due to its light weight, aluminum aerial cable can be installed to the same sags as copper cable, provides as much clearance, and reduces the tension at pole supports. Additionally, this reduced weight in some cases permits reduction of the messenger size. Less congestion on poles; decreased pole height when used for joint construction with telephone company; improved voltage regulation due to reduced reactive drop.

SAVE on first costs, save on labor and maintenance expenses now with KW aluminum aerial cable. KW preassembled aerial cable is available in both reverse lay and unilay in either aluminum or copper. For immediate service or more detailed information, call the Kaiser Aluminum sales office or KW distributor listed in your telephone directory.

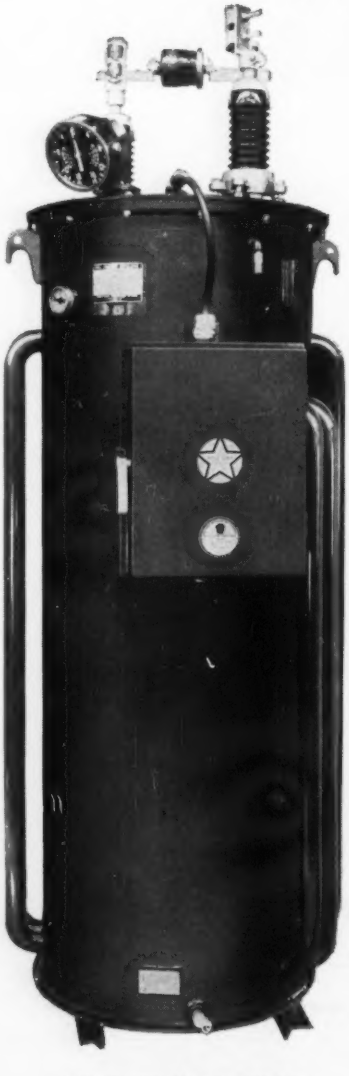
Kaiser Aluminum & Chemical Sales, Inc., 1924 Broadway, Oakland 12, California.

KAISER ALUMINUM

"IF IT CARRIES CURRENT, KW CARRIES IT!"

See "MAVERICK" • Sunday Evenings, ABC-TV Network • Consult your local TV listing.

the **story** of Pennsylvania's NEW Pole Star Regulator



Station-type Pole Star Regulator

My name's Casey . . . Jerry Casey.

I'm a salesman. For several months I've been talking with utility people in many sections of the country about Pennsylvania's new Pole Star Regulator.

The other day I was telling our advertising manager about the enthusiasm with which the PSR is being received. Next thing I know, he's shaking my hand and saying, "Congratulations!"

"For what?" I ask.

"For being selected to write our next regulator ad," he says. "Just jot down the facts, that's all. Write them as you speak them."

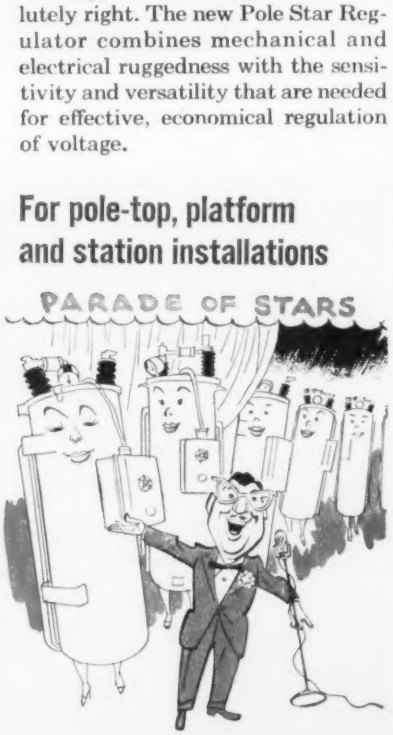
OK, so I'm a fall guy. But I just can't pass up *any* opportunity to tell the story of the new Pole Star Regulator.

A combination that can't be beat

Now—for the first time—two of Pennsylvania Transformer's most outstanding developments have been joined in a single, incomparable product. They are—the famous Pole Star distribution transformer . . . and . . . Pennsylvania's performance-proved load tap changer.

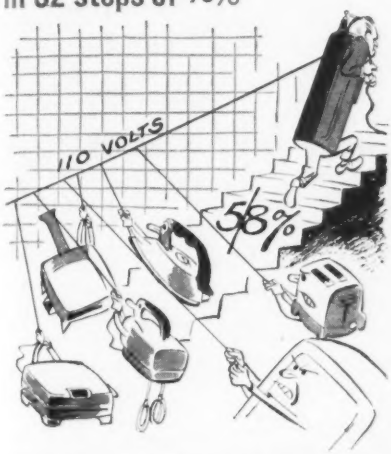
If you think this is the sort of "partnership" that can produce nothing but the best, you are absolutely right. The new Pole Star Regulator combines mechanical and electrical ruggedness with the sensitivity and versatility that are needed for effective, economical regulation of voltage.

For pole-top, platform and station installations



But don't think for a moment that the new Pole Star Regulator is available in just a few "introductory" sizes. The fact is, a full range of distribution sizes and capacities . . . 27 different ratings, to be exact . . . is now in production. Most regulators are equipped with both hanger brackets for pole-top installation, and hold-down lugs for mounting on platforms or cement pads. The larger, station-type units have the sturdy Pole Star base.

Regulates automatically in 32 steps of 5/8%



How does the Pole Star Regulator function to maintain voltage at a constant level? Voltage is raised or lowered, according to the load at any given time, in what Pennsylvania Transformer studies indicate is the most desirable pattern: that is, in 32 steps of 5/8%. An automatic tap changer adjusts the voltage to this degree whenever it remains outside a narrow band of plus or minus one volt for more than ten seconds—or whenever fluctuating voltage averages more time outside the operating band width than within it. (Both the time delay and the operating band width may be varied to suit local conditions.) The normal operating range of the Pole Star Regulator is plus or minus 10%, with 16 tap positions above normal and 16 below.

Mor-Amp feature gives 60% extra capacity

You can bet on those Pole Star designers, however, to make allowance for unusual conditions—and that's just what they have done with the Mor-Amp feature. Even a child could operate the Mor-Amp control, which reduces the range over which the regulator functions in order to provide additional capacity. As much as 60% extra capacity—up to 668 amperes—can be obtained this way.

You might even say the Pole Star Regulator has telescopic vision—or "telepathic brain" might be a better way to put it. By means of a line drop compensator, adjustments are made for any low voltage conditions that exist at points far removed from the regulator, even though voltage at the regulator might be satisfactory.

A new tap changer backed by 20 years' experience

As for the real heart of the regulator—the tap changer—you get the full advantage of Pennsylvania's 20 years of actual manufacturing experience in the highly technical field of load tap changing. I just wish all of you could see the direct-drive mechanism in action! Used on all regulators rated 13800 and 14400 volts or with current ratings from 201 through 668 amperes, it measures up, in all respects, to Pennsylvania's well-known power transformer load tap changers! It has the same operating smoothness and long-lasting ruggedness—in fact, its design and construction features are basically the same as those that have stood the test of time in power transformer applications.

The smaller, spring-driven tap changer—used on regulators rated 7620 volts and below and with current ratings less than 201 amperes—also is a honey. Both tap changers are guaranteed to help your customers to live better electrically.

Quiets customer complaints about voltage

But why not see for yourself how the new Pole Star Regulator provides efficient, economical regulation of voltage . . . maintains consistently satisfactory voltage for all purposes . . . and quiets customer complaints regarding voltage to a barely audible whisper? Your order will get prompt attention at Pennsylvania Transformer, whether your needs are for a single unit or for several dozen.

Or, if you would like more information about the Pole Star Regulator, please drop me a line at the address shown below, or telephone Sherwood 5-9100. If I have not already visited your company, perhaps you would like to arrange a demonstration for some of your engineering and purchasing personnel.

Sincerely,
Jerry Casey

Pennsylvania Transformer Division

McGraw-Edison Company

Canonsburg, Pa. Greater Pittsburgh District

resists water...like KERITE INSULATION

It's the **KERITE** *that makes the difference*

KERITE CABLE

30 Church Street, New York 7.
Branches in Ardmore, Pa., Boston, Cleveland, Chicago, Houston, St. Louis, San Francisco, Glendale, Cal.

Editorial Comment

JUNE 29, 1959

Better Methods Open Way to Real Savings

The industry's current budget for non-generation construction plus operating, and maintenance expense is well over $3 billion. This budget provides many opportunities for savings. Such economies in individual items can amount to thousands of dollars in the aggregate for any utility.

To bring about these savings in their respective fields, utility men in construction, operation, and maintenance can and do apply ingenuity to find and put better methods to use. Illustrations of these better methods and their associated savings are carried each week on our Electric Utility Methods pages. They are given special emphasis in the quarterly special report on Electric Utility Methods beginning on page 127 of this issue.

For example, construction crews of one utility worked closely with design engineers in rebuilding a four-circuit line for 115-kv operation to better utilize an 80-ft right-of-way. Another company improved its method of ground controls for more accurate aerial surveying of coal supplies. Maintenance men of a third devised gages that helped return a waterwheel to original specifications and thus increased the efficiency of hydro operation. These stories are followed by more than a score of others which detail better methods in many areas of the electric utility system.

The development and use of better Electric Utility Methods is an avenue that all utilities can explore further for real savings in the many small items comprising the budgets for construction, operation, and maintenance.

"T-H Index" Should Aid Utilities

Some Weather Bureau stations last month began issuing "Discomfort Index" figures along with hourly weather reports. After a flurry of opposition to the "Discomfort" tag developed from civic promotion groups, some stations changed the name to "Temperature-Humidity Index," ("T-H" for short). The station may eventually supplement hourly figures with forecasts.

The new index is computed from wet- and dry-bulb temperature readings, with intent to reflect the degree of comfort or misery people will experience under various combinations of temperature and humidity.

We see two possible benefits which electric utilities may derive from the broadcasting of this data.

First, the constant reminder to an individual that he is uncomfortable heightens his awareness of it. Thus the "T-H" index may become a psychological spur to him to buy an air conditioner if he lacks one—or to lower his thermostat if he has a conditioner. Result for the utility: increased kwhr sales.

Second, the "T-H" data may eventually become useful for summer load analysis. Of course many utilities already have fairly precise indices for short- and long-term forecasting of air conditioning load. However, it is possible that a correlation can be drawn between "T-H" readings and load. Analysis of past weather records converted to "T-H" form and compared to corresponding system load would check this without much effort.

If the correlation can be established, utility operators and planners may be able to find ways of using the Weather Bureau "T-H" data to simplify their present calculations.

Supervisors Relax as PS Strike Ends

Walkout lasts 39 days before IBEW settles on 5.34% boost. About 800 men handle jobs vacated by 5,400 strikers

The largest number of electric utility workers to ever stage a strike last week agreed to return to work. They settled with Public Service Electric & Gas Co on a 5.18% wage increase 39 days after the walkout began.

In addition to this 5.18% wage hike, the company agreed to the following fringe adjustments:

- Increase to $2 per employee the $1.50 it now pays towards hospitalization.
- Payment of $1.25 a day for area maintenance to employees who rotate among the company's generating plants.
- Slight adjustments in some job classifications.

The overall increase, including fringes, amounted to 5.34% as compared with 4.97% offered by the company.

The settlement followed a meeting in New Jersey Gov Meyner's office between the IBEW, PS officials, federal and state mediators, and the governor. State officials had made no attempt to invoke a state law banning utility strikes.

For most of the 1.5-million electric customers served by PS, the strike caused no inconvenience. At the seven all-but-isolated power plants, about 300 supervisors worked shifts of 8-hr on and 8-hr off to maintain generation requirements. Another 500 foremen and supervisors handled routine distribution outages, along with occasional cases of sabotage.

Some Comforts of Home

The power stations, already equipped with cafeterias and sleeping accommodations, served as home for the supervisors. TV, radio and reading material helped them pass free time, while telephone calls kept them in touch with their families. In the few instances of emergencies at home, the men crossed and re-crossed picket lines without incident.

Morale of the supervisors remained high during the walkout, PS said. The company made adjustments in paychecks for their extra duties. Union claims of excessive salaries were exaggerated, the company said.

New residential connections were handled with only slight delays. Some large new commercial and industrial customers had to wait.

At first the union did not offer a counter-proposal to the PS offer of a 4.78% wage increase, which amounted to 4.97% with fringe benefits included. Later, the strikers' representatives came out for a 6¼% boost. This was then changed to 6% plus fringe benefits.

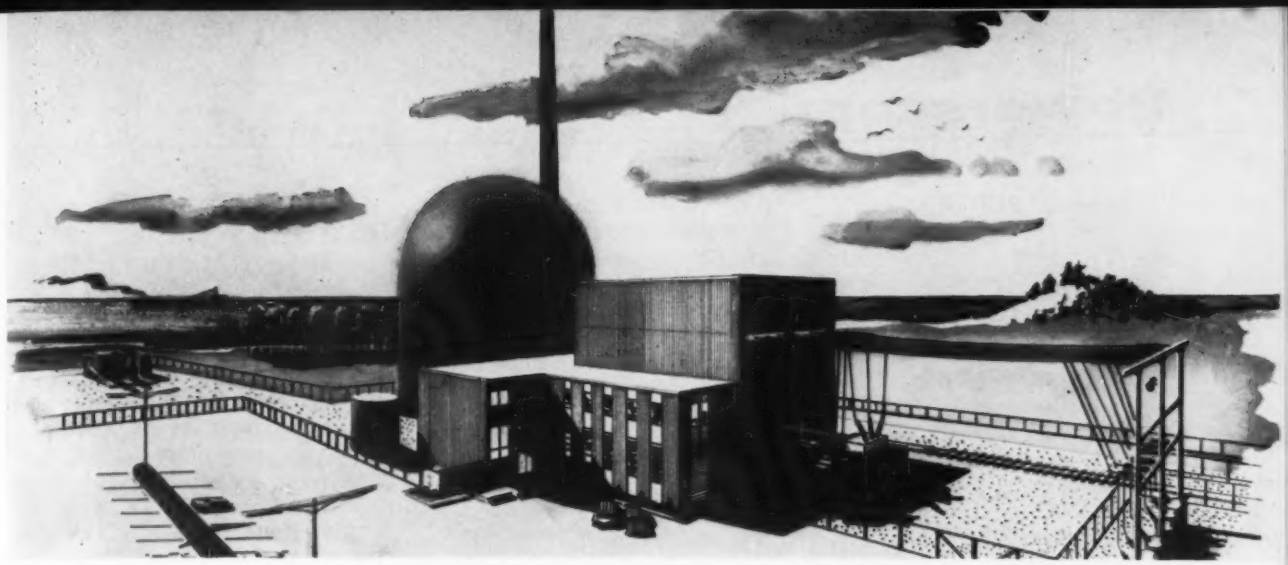
During the strike two neighboring utilities settled on wage increases providing a higher percentage than PS first offered. Long Island Lighting Co negotiated a 5% increase under a wage reopener clause as it entered the final year of a two-year pact. Orange & Rockland Utilities, Inc, in Nyack, N. Y. granted a 5½% boost. PS officials pointed out when the strike began, however, that its original offer would make its pay scale the highest of any electric utility on the Eastern Seaboard.

PS posted rewards of $10,000 for information on and conviction of vandals who caused some scattered outages. In one case, a submarine cable serving Liberty Island was damaged. Engineers installed a temporary line while portable generators were set up for the few homes. The incident didn't dim the Statute of Liberty's torch.

Newark News Photos

EIGHT HOURS ON, eight off was supervisors' schedule at seven plants. TV, radio, ample reading material, and telephone calls home helped pass time

WASH-'N-WEAR was eased for Joe Britton by built-in laundry equipment



A-Plant Slated By Consumers Power

50-Mw boiling water reactor will be completed by 1962 for cost of $30 million. Main goal is data on high power density and high specific power. GE to build equipment

A 50-eMw nuclear power plant will be built on the shores of Lake Michigan, it was announced June 19 by Consumers Power Co. The Big Rock Point plant, employing a direct-cycle, high power density, forced circulation boiling water reactor, will operate in 1962.

With the announcement, Consumers filed a petition with the Michigan Public Utilities Commission, asking approval of accounting plans for the $30-million project. The company would charge $10 million, the estimated difference between the nuclear plant's cost and that of a 50-Mw conventional station, to research and development over a period ending in 1973.

Noting that the recently-passed AEC authorization bill provides for limited R&D assistance and fuel cost waivers for projects of this type, Consumers Pres Dan E. Karn stated the company was studying whether to apply for the aid.

Consumers selected General Electric Co to furnish nuclear reactor, instrumentation, fuel and power equipment. Bechtel Corp will be prime contractor and engineer-constructor. Commonwealth Associates will engineer certain facilities.

Primary objective of the installation will be development of engineering and economic data on high power density and high specific power. Consumers and GE jointly will undertake R&D on reactor core and fuel design, leading to an increase in capacity to 75 eMw within 4½ years of initial operation.

The Big Rock Point plant will follow Pacific G&E's 50-eMw natural circulation boiling water plant at Humboldt Bay, Calif., as the second developmental station under GE's "Operation Sunrise."

Turbine Designed Specially

Gross electrical output will be 50 Mw at 1.5-in. turbine exhaust. A single-shaft 3,600-rpm single-flow turbine will be designed specifically for this installation.

In forced circulation operation, water at near-saturated temperature will be pumped into the reactor vessel, flow up through the core, and boil. The steam-water mixture then will flow to an external, conventionally-styled steam drum. After mechanical steam separation, steam will flow directly to the turbine at 1,000 to 1,450 psi. An emergency heat exchanger system will provide a separate heat sink in event of a scram.

The 108-in. ID by about 33-ft high reactor vessel will be carbon steel lined with stainless. Fuel will be sintered pellets of UO_2 enriched to about 2.3%, and clad in zircaloy-2. Control rods will employ a 2% natural boron poison in stainless steel.

The control system will match reactor output to turbine load requirement by following steam pressure. This permits a high degree of reactor self-control, minimizing pressure effects on voids, and essentially allowing the negative void coefficient to hold reactor power.

Water will be used where possible as a radiation shield. The reactor containment enclosure, envisioned as a 90-ft dia domed-steel cylinder, will house all fuel and control rod handling facilities. Within the cylinder, a fuel storage pool will be separated from the reactor.

Liquid radioactive wastes will be collected, treated and, if of sufficiently low activity, discharged. Higher level waste will be treated and stored on site. Waste treatment will be allocated a separate structure.

Radioactive gaseous wastes will be diluted and discharged via a monitored stack equipped to maintain discharge activity below permissible limits.

A turbine building will house turbine-generator, and control room auxiliaries. Non-radioactive equipment in the turbine area will be shielded for limited access during operation. A separate heating plant will be provided.

Powerscope

'Influence' Bills Hit

Federal Power Commission officials and several industry spokesmen testified recently before the House Legislative Oversight Subcommittee against two bills (HR-4800, HR-6774) aimed at ending "improper influence" and increasing the efficiency of various federal regulatory commissions, including the FPC.

FPC Chairman Jerome Kuykendall agreed that improvements could and should be made in FPC regulations, but he cautioned that the two specific bills, introduced by Subcommittee Chairman Oren Harris (D-Ark.) might cause more harm than good. The bills, among other things, would restrict the freedom of FPC commissioners and examiners to consult with their staff members and industry members on pending cases. Stiff fines would be authorized to enforce the restrictions.

Randall Leboeuf, Jr., attorney for power and gas companies in cases before the FPC, criticized the bills as "unduly restrictive." He added that such "blanket" legislation—aimed generally at all federal regulatory agencies—would "delay, complicate and hamper the FPC in the proper performance of its mission."

A Shift in Service

Montana Power Co is seeking state regulatory commission permission to discontinue steam heating services in Missoula. Business has dropped about 50% since the introduction of natural gas, MPC said. Narragansett Electric Co has applied for SEC authorization to sell Warren and Bristol, R. I., gas facilities to Bristol & Warren Gas Co for $460,000.

Kings River Enterprise

An important part in the utilization of California's Kings River resources was described as "one of the big monuments to free enterprise" in the state by Norman R. Sutherland. The Pacific Gas & Electric Co president told 500 visitors at the Balch No. 2 Powerhouse dedication earlier this month that the irrigation aspects of the project represent "more than $70 million in private capital, earned or financed by the farmers themselves."

The results of such enterprise makes it "difficult to understand why some people who thrive in the blessings of our way of life would destroy it," Sutherland said.

In the ceremony, Charles L. Kaupke, controller of irrigation releases from the river, 1917 to his retirement in 1955, inaugurated operation of the plant by telephone 65 mi away in Fresno. Balch No. 1, Haas Powerhouse and the new unit bring PG&E's capacity on the river to 254 Mw. When Kings River Powerhouse is completed, capacity will be increased to 296 Mw.

High Cost of Scrubbing

A report on costs and methods of installing coal-scrubbing equipment in plants of 120-Mw capacity has been released by the Bureau of Mines. The scrubbing, which reduces sulfur dioxide emissions from plant stacks, requires equipment costing between $1.75 and $5 million a year, based on an estimated annual consumption of 475,000 tons of coal. This comes to a $1.40 to $2.20 range per ton of coal consumed. For a copy write Publications-Distribution Section, 4800 Forbes Ave., Pittsburgh 13. Ask for Report of Investigations No. 5469.

Success With Batteries

The Scottish region of British Railways is testing the first twin-car battery railcar in Britain. Trials are proving successful, BR says. The batteries, each weighing eight tons, are carried in two half sections under the carriages and comprise 216 lead-acid cells with 1,070 amp-hr capacity at 440 v. Battery chargers include circuit breakers, transformers, and rectifiers. Charging is at a high rate while cars are at a station platform.

A-Power Advisors Named

New York Gov Rockefeller has appointed members of a General Advisory Committee, which will help guide the efforts of the state's Office of Atomic Development.

New members include James F. Fairman, Consolidated Edison Co senior vp and Thomas F. Farrell, New York Power Authority consultant (3-year appointments); Lee L. Davenport, Sylvania-Corning Nuclear Corp president and Earle J. Machold, Niagara Mohawk Power Corp president (2 yr); Wilson D. Leggett, Jr, Alco Products, Inc, and John R. Menke, Nuclear Development Corp president (1 yr).

Francis K. McCune, General Electric Co vp, was named chairman of the committee earlier this year. The group will advise on state policy, federal-state relationships, research, and regulatory coordination as it pertains to atomic energy.

3-Way Pool Arranged

In the event of a large-scale outage, three Arizona utilities will pool their generation capabilities, under terms of an agreement signed recently. Arizona Public Service Co, Salt River Power District, and Tucson Gas, Electric Light & Power are the participants. The trio already is interconnected and is linked with nearby U. S. B. R. projects.

Saran Wrap Spots Culprit

When a Virginia Electric & Power Co unit's condenser tubes began leaking, Bridgeport Brass Co solved the job of finding and plugging the leaks while the machine was on the line. Dow "Saran Wrap" was used to cover exposed tube sheets before drawing vacuum by drainage of circulating water. The leaking tubes drew in the plastic film to indicate the culprit.

New EW Publisher, Editor Named

Shew to be publisher of Electrical World. Hochgesang becomes editor. Black joins Tampa Electric as vice president

Warren W. Shew has been named publisher of Electrical World, effective August 1. Charles F. Hochgesang has been made editor. Fischer Black, present editor and publisher, will join Tampa Electric Co as administrative vice president on that date.

Shew has been advertising sales manager of Electrical World since September, 1954. Before that he was a district manager on Electronics and Nucleonics magazines in the Philadelphia office of McGraw-Hill Publishing Co.

He was also with the General Electric Co for 11 years. His positions there included application engineer in the Machinery & Builders' Dept in Schenectady, N. Y.; assistant sales engineer and sales engineer in Philadelphia; and manager, applications engineering, U. S. Naval Shipboard Installations, Norfolk, Va. He was sales engineer in the Electric Utility Dept in Philadelphia before he joined McGraw-Hill in 1947.

Shew is a member of the American Institute of Electrical Engineers and National Industrial Advertising Association.

Hochgesang was most recently assistant to the editor of Electrical World. Prior to that he was western editor for 2½ years.

He joined Electrical World from the Bechtel Corp where he spent eight years as a senior engineer on power plant and heavy industrial design.

HOCHGESANG

SHEW

Hochgesang's first position was with General Electric in their engineering training program. He was then with Kellex Corp in New York and Oak Ridge, Tenn.; with Carbide & Carbon Chemicals Corp in Oak Ridge; and with General Electric's construction division in Richland, Wash.

A registered professional engineer in California, he is a member of AIEE and of Tau Beta Pi, U. S. engineering honorary group.

Black has been editor of Electrical World since 1948, and publisher and editor since 1954.

FPC Ups Estimates, Sees 421-Million Kw Capacity in 1980

The nation's utility systems (excluding Alaska) will need 421-million kw of installed generating capacity by 1980, a new Federal Power Commission survey indicates. This is 27-million kw higher than the previous estimate for 1980, made last June by FPC in the face of the recession.

The higher estimate is based on an upward revision of expected peak power needs in 1980—now predicted at 366-million kw. (EW's estimate for 1975 is 391-million kw.) U. S. total energy requirements for 1980 will be 2.012-trillion kwhr, the FPC now predicts, up 7.4% from its previous estimate.

Installed utility generating capacity for 1958 was 142-million kw, peak demand was 120-million kw, total energy needs were 651-billion kwhr.

Breakdown Supplied

The total 1980 energy requirement of 2.012-trillion kwhr will be broken down as follows (in millions of kwhr): Industrial 870,433 (up 5% from the previous FPC estimate); non-farm residential, 506,431 (up 12%), commercial, 306,258 (up 13%); farm (excluding irrigation and pumping), 45,732; irrigation and pumping, 18,816; street and highway lighting, 15,045; electrified transportation, 5,025; other deliveries, 42,667; losses and unaccounted for, 202,187.

Utilities' needed installed capacity for 1980 should be divided 57-million kw for hydro and 356.4-million kw for steam and nuclear power generation, and 7.6-million kw for internal combustion. By contrast, 1959 capacities were: Hydro, 29,363,000 kw; steam and nuclear, 10,435,000 kw; internal combustion, 2,615,000 kw.

Industrial generating capacity for 1980 (separate from utility estimates) must total 30-million kw, the FPC also predicted. This would be divided 26-million kw for steam and nuclear; 3.3-million kw for internal combustion and 700,000 kw for hydro.

British See Need for Load-Factor Emphasis

Despite gains, industry must push off-peak use and improve research. Atom-power break-even date is set at 1970

J. H. M. SYKES, Special London Correspondent

A few prickly spots lie beneath the glossy outward appearance of a prosperous British electrical manufacturing industry and a burgeoning nationalized utility. The blemishes recently were examined at the electrical industry's annual get-together —the Electrical Power Convention.

"Matchless progress" has been achieved by both the manufacturing and supply sides in the last decade, said Philip J. Noel-Baker, former Socialist minister of fuel and power and now opposition member of Parliament. Before turning to his critique he cited:

Noel-Baker Cites Gains

- A rise in consumer rates of only 34% vs a general commodity price hike of 66%.
- A price per kw of big new plant units lower than a decade ago.
- A 28-cu-ft space of plant per kw vs 50 cu ft in 1948.

Noel-Baker then suggested the industry as a whole was not doing enough to improve load factor. The vitally necessary corrective: better highway lighting, greater speed in railroad electrification, and development of city transportation electric vehicles.

Not Enough Spent on Research

As for research: The nationalized utility had spent only a 19th of 1% of its investment on research over the last 16 years, he said. This, Noel-Baker believes, is far from enough. In certain fields manufacturers, too, were to blame. The "grotesquely inefficient" storage battery was a case in point, he said.

The concluding session of the convention, a forum, produced other evidence of stress despite the jamboree appearances of 3,000 industry leaders and their wives celebrating a successful year. A panel made up of both segments of the industry reflected the strong division of opinion on price maintenance, recently highlighted by new anti-trust legislation.

Debate Price Agreement

To the question, "would the end of price agreements be in the interest of the industry as a whole?" H. G. Nelson recalled how manufacturers suffered from cut-throat competition in the Thirties. Now, 25 years of price agreement had resulted in an efficient industry, technically second to none, said the managing director of English Electric.

Sir Christopher Hinton, chairman of the Central Electricity Generating Board, said he too did not like cut-throat competition, but the manufacturing industry, at times, had been "damn silly" in applying price agreements: Eight tenders all exactly alike in price made the customer "hopping wild."

A vast educational program was needed to make consumers realize the part they can play in making the whole industry more efficient, said Sir Henry Self, Chairman of the Electricity Council. Government departments and municipalities seldom realize how vital it was that all-peak-usage equipment should be used in building programs.

A-Power Date Pushed to '70

A questioner asked if the panel agreed with a recent forecast by Sir John Cockroft, Britain's leading nuclear scientist, that nuclear power would become 20% cheaper in cost-per-kw by 1970. Sir Hinton said his own forecast had been a break-even date of 1965, but as capital costs of coal-fired stations in Britain had dropped more rapidly than expected, the break-even date was now likely to be 1970.

Nelson added that considerable uneasiness existed in the nuclear plant industry. It was costing a great amount of money to develop large nuclear power stations, and there seemed to be doubt as to whether this could be recovered.

Gas Turbines Will Firm-Up B.C. Hydro

A small chunk of thermal energy can economically firm up secondary hydro power which otherwise would not be available for dependable energy. This is the finding of B. C. Engineering Co, Ltd's Robert P. Dohan.

"For stand-by services and firming up hydro, gas turbine installations possess a number of technical advantages over conventional steam turbine plants," he told a Vancouver Electric Club meeting recently. The advantages: "Lower capital costs, a cold start-up to full load period of less than one-tenth the time required by steam turbines and a positive power correction at lower ambient temperatures."

Dohan, project manager of B. C. Electric's Port Mann gas turbine plant, said careful study has led to installations of a two-shaft, two-stage, intercooled, re-heat, open-cycle nature. "At full load, overall thermal efficiency will be in the order of 22%," he said.

Four 25-Mw gas turbine units will be in operation at Port Mann upon completion late this summer, making the plant the largest of its type in the world. Cost, exclusive of the switchyard, will be about $12 million, or $120 per kw. Fuel consumption will be 11 mcf of natural gas or 48,000 gal of crude oil a day for each unit.

The plant will have complete remote and supervisory control that will cost an estimated $2.50 per kw. With year-round manual operation, cost per kw produced would be increased by as much as 50%, he pointed out.

Control and telemetering equipment will be linked with the utility's headquarters 15 mi away. It will take about 20 min for a unit to reach full load after receiving a start impulse, Dohan said.

PCEA Told Securities Must Sell

San Francisco meeting hears regulation hampers utility financing; industry must bring facts before the public to win its support

Regulation today handicaps the electric utility industry in obtaining funds for necessary construction, the Pacific Coast Electric Association was told at its recent annual convention in San Francisco, Calif.

Better rates of return will attract investors, now chary of fixed-income securities, said G. M. Ives, Morgan Guarantee Trust Co of New York. Regulatory bodies, he said, must recognize prevailing inflationary trends by permitting utilities to adjust more rapidly in the competition for funds with other industries.

Between now and 1970, the industry will need $54 billion for construction, only 40% of which will be generated internally, Ives continued. Locally, in the area served by PCEA members, he added, $4 billion must be raised in the money markets of the nation.

Utility employees, stockholders, and the general public must be instructed in the true causes of inflation and increasing taxes, urged J. K. Horton, president, Southern California Edison Co. Without some public understanding, the power industry is a "sitting duck" for those advocating government control. But public opinion polls, he said, indicate that the people, once informed, favor fair treatment. He pointed out that inflation is man-made, not inevitable.

The industry's first objective is to hold the line against inflation without sacrificing the earnings necessary for the growth of business, said C. H. Bartlett, Westinghouse Electric Corp. Its second objective, he went on, is to continue expanding the use of electric power, in this way achieving a better balance between winter and summer peaks.

The industry's future profits must be based solidly on technological achievement, he said, reviewing recent developments in equipment. Technological development, according to Bartlett, enabled the industry to reduce the cost of electric power from double that of the best other source in 1926 to a level 23% lower in 1958.

LESLIE HICKS, president, Hawaiian Electric Co, and retiring PCEA president, discusses industry problems with A. S. King, EEI president, and N. R. Sutherland, Pacific G&E president, at Pacific Coast Electric Association's convention

Digital Computers Save $1.1 Million for Utility

Digital computers saved Detroit Edison Co $1.1 million in solving engineering problems, A. P. Fugill recently told the Edison Electric Institute's Electrical System & Equipment Committee at Pittsburgh. Other benefits in many instances were more valuable than the savings, he said, in presenting a report written by L. W. Coombe of the same company.

Evaluation of computer use was based upon programs developed and applied during the past three and a half years and credit for continued use of the programs for another six years, Fugill said.

The speaker noted that the savings in generation, analysis of loading and losses, and billing for interconnection flows will total $0.75 million during the ten-year period. Capital savings from optimizing station and system designs have a present worth of $0.73 million. Computer operation is expected to cost $0.37 million present worth during the period, he said.

He illustrated capital savings by citing the design of columns for power plants. Because the computer determines optimum size in 1 min, column selections can be deferred until final equipment loadings are known. This permits substantial savings in steel.

Evaluation of the Shippingport nuclear power plant after 16 months of service shows that it is well adapted to utility operation, said G. M. Oldham, Duquesne Light Co. Load swings, startups, and shutdowns are limited by conditions in the turbine rather than in the nuclear part.

The Shippingport reactor has proved to be reliable and trouble free, and shows a core life at least double the original estimate.

But maintenance requires a larger and better trained force than a conventional steam plant, he said, because of the inaccessibility of components, the complex instrumentation and controls, and the precautions against radiation exposure.

Load-tap-changer contacts can be checked for correct operation by use of a six-element portable oscillograph, said J. A. Herold, Baltimore G&E Co.

Test connections, he explained, are made with clip leads, and the tap changer is run through its full operating range in both directions. The traces check each switching operation before line voltage is impressed.

A-Power Holds Center

- Nuclear plants hold promise for low-cost power for small public systems, General Manager Alex Radin tells American Public Power Assn in Seattle
- Speakers also see load-building and rate-making as ways to realize 16th annual convention's theme, 'Low Cost Power for Prosperity'

CHECKING CONVENTION PROGRAM are: l to r, W. S. Peterson, Los Angeles Dept W&P; P. J. Raver, Seattle City Light; V. M. Cleveland, Clark County PUD; I. C. Laird, Coos-Curry Co-op; and W. A. Pearl, Bonneville Power

Nuclear power is taking the lead in the future planning and programs of American Public Power Assn.

Combined with a bevy of load-building, rate-making, and interconnection plans, A-power looks like the vehicle which APPA is taking to achieve the theme of its 16th annual convention, "Low Cost Power for Prosperity," held May 26-28 in Seattle, Wash.

Alex Radin, general manager of APPA, first brought up the A-power subject in his annual report as the convention began: "In view of the fact that the U. S. is still some distance from achieving economic nuclear power, some may wonder why APPA is placing so much emphasis on this field," Radin declared, after reporting on the association's nuclear power activities.

He went on to explain that "ultimately atomic energy will be a major source of power in the U. S." and that "the atomic power program possibly offers some very real potentialities in the way of making low-cost power available for the smaller utilities which numerically comprise the bulk of our membership."

That set the stage for speeches later in the week by Rear Admiral H. G. Rickover and Sen Henry Jackson (D-Wash.).

Rickover devoted his remarks largely to the Shippingport A-plant, but in a preceding press conference, he endeared himself to the hydro-rich Pacific Northwest by lauding water power as "the cheapest we can get." He urged construction of more dams. The chief value of the Shippingport reactor, the admiral told the convention, lies in "advancing the art" of reactor operation, and this should be "the primary objective of any power reactor now being considered."

"Merely operating a reactor does not guarantee that the art will be advanced or that useful knowledge will be developed," said Rickover. "There have been reactors built, and some are being built now, with almost no instrumentation beyond the minimum needed to operate them, and with no organized test program. We have found that it takes 20 technically trained Duquesne Light Co people full time to think through a test program for Shippingport, to write up test procedures, to analyze data, draw conclusions, and write up the results."

Decries A-Power Cost Estimates

The admiral decried attempts to estimate the cost of A-power, describing early estimates as "meaningless" and insisting that "atomic power development is a technical matter, that the rate at which it advances depends upon solving many difficult technical problems, and that we can best judge the state of the art by looking at the technology which is being developed, and at the problems which remain."

Sen Jackson called for cooperation of public and private power groups in the development of atomic power. "Our nation," he said, "has spent thousands of hours of pointless debate over a problem that really does not exist—public or private development of atomic power. Far better if we had spent every one of those same hours in attacking a problem which does exist—how to build and operate reactors. The real question we face is technical, not ideological."

NEW PRESIDENT of APPA P. J. Raver, left talks with Alaska Sen. E. L. Bartlett, center, as APPA General Manager, Alex Radin listens

Stage at APPA Annual Convention

Jackson declared that "large-scale government financial support is now needed" to build prototype plants, since "only the government has the necessary resources." He cited the wave of consolidations of small nuclear firms with larger equipment concerns, and warned: "Unless we undertake more prototype plants in this country, there may soon be only two or three giants . . . in the atomic power field." Jackson doesn't think this would be a healthy situation.

The convention's interest in nuclear energy found its way into the resolutions, urging the government to "adopt a clear and positive policy and program for developing atomic power," and to undertake the building of A-plants of various types.

But if nuclear power held center stage, it was not the only name in the cast.

'No New Starts' Criticized

Sen E. L. Bartlett (D-Alaska), keynote speaker, criticized the "no new starts" policy of the Administration with regard to hydroelectric projects. He characterized the government's failure to develop Alaska's water power as "penny-wise but pound-foolish." Bartlett feels the federal government will have to develop the 49th state's water resources for defense reasons alone, and wants the Corps of Engineers to do the job.

Olds, New Rate Plan

For utilitymen, however, possibly the most interesting innovations in traditional utility practices came from one-time FPC Chairman Leland Olds, a long-time public power advocate. Olds called for a new concept in residential rates based on future business, rather than "last year's business, in which revenues were restricted by sales which were restricted by rates which were based on costs associated with restricted sales."

Said Olds: "Base your rates on your future business. Then your rates will be low because your costs will be low because your sales will be high because your rates will be low." Olds recommends setting rates as follows:

1. Set as your goal as the number kwhr you intend to sell your average residential or farm consumers per year. That goal will be the all-electric home and/or farm, and usage, reflecting the latest applications, can be put at 24,000-30,000 kwhr a year. Beyond this, Olds looks to "picking up a constantly increasing off-peak load from the recharging of electrically operated motor vehicles."

2. Find out what price or rate is necessary to reach that sales objective, i.e., "the rate . . . that will make it good business for the home owner or farmer to displace other forms of purchased energy with electricity."

3. Use modern technology to adjust costs to make the rates economicably feasible with an increasing volume of sales. Olds advocates the "100% American mass-production, mass-sales approach. This takes advantage of the fact that as volume increases, unit cost falls rapidly. But it goes further and puts the best technical brains to work on finding new ways of performing every task . . . so that unit costs will continue to decline in spite of rising price levels."

Municipals Still Declining

Joseph Swidler, former general counsel for TVA, brought up to date figures he had presented at last year's convention on the decline in the number of municipal power systems. "New figures indicate that the trend, if anything, has accelerated," Swidler said. "Whereas there was a loss of only a dozen systems from 1954 to 1955, from 1,980 to 1,968 systems, in the next year the number declined to 1,895 systems, or a loss in one year of 73 systems." Swidler pointed out that most of the municipals that went out in 1956 did not have their own generation. His solution to stopping the decline: integrate. "If public systems are to continue to do a creditable job of bringing down power production costs . . . they must find ways to integrate their systems."

Raver Is New President

Paul J. Raver, superintendent of Seattle City Light, was elected president of the association to succeed S. T. Anderson of Springfield, Ill. Raver was also given APPA's highest award, the Distinguished Service Award, and his utility won the first-place award for major cities in the APPA Best Annual Report Contest.

Dewey DeBoer, director of the Nebraska Public Power System, was advanced from second to first vice president, and H. D. Miller, general manager of public utilities at Springfield, Mo., became second vp. C. E. Pray of Board of Public Utilities at Kansas City, Kan., was re-elected treasurer. Miller and Pray, along with Knoxville Utilities Board's Clyde Carpenter, Jr, were the winners of the Harold Kramer Personal Service Award.

F. H. King of Holyoke, Mass., and Q. E. Eddens of Decatur, Ill., were reelected directors. The following are new APPA directors: M. L. Burgin, Bloomington, Ill.; J. P. Gallagher, Piqua, Ohio; Frank Posey, Lubbock, Tex.; and I. L. Bateman, Los Angeles, Calif.

APPA SPEAKERS Admiral H. G. Rickover confers with Washington's Sen Henry Jackson

Muskeg Needs Special Tower

Boggy terrain challenges builder of 138-kv steel-tower line to metallurgical plant

JOHN O. TONNING, Structural Engineer, Anaconda-Jurden Associates, Inc, New York, N. Y.

Muskeg, a substance partly decayed vegetable matter and partly soft mud and silt, posed formidable design and construction problems in the building of a mining company transmission line in northeastern Minnesota. Of the line's 308 steel, double-circuit towers, foundations for 58 of them were designated for the boggy terrain, where they required special provisions for both design and construction.

The 138-kv transmission line joins the power plant at Taconite Harbor on Lake Superior with the Erie Mining Co's metallurgical plant site at Aurora. The latter is some 75 miles north of Duluth, near the town of Hoyt Lakes in the Mesabi Range Country. The line roughly parallels the route for the Erie Mining Railroad.

The double-circuit steel towers consist of three basic sections. The body section is 52 to 92 ft high; the upper or arm section, 35 to 39 ft high; and, the standard leg section, 11 ft, 6 in. high, plus variable leg extensions to suit changes in elevations between legs. Average tower heights are above 100 ft, average spans 1,000 ft, and maximum span 2,000 ft. The towers are in five broad groups, distinguished by the amounts of load and the angularity of the line. The groups are:

Type A—Normal suspension towers and light angle towers up to 2 deg.

Type B—Light strain towers for zero to 15 deg and for extra long spans.

Type C—Medium strain towers for 15 to 25 deg.

Type D—Heavy strain towers for 25 to 35 deg and for zero-deg deadend towers.

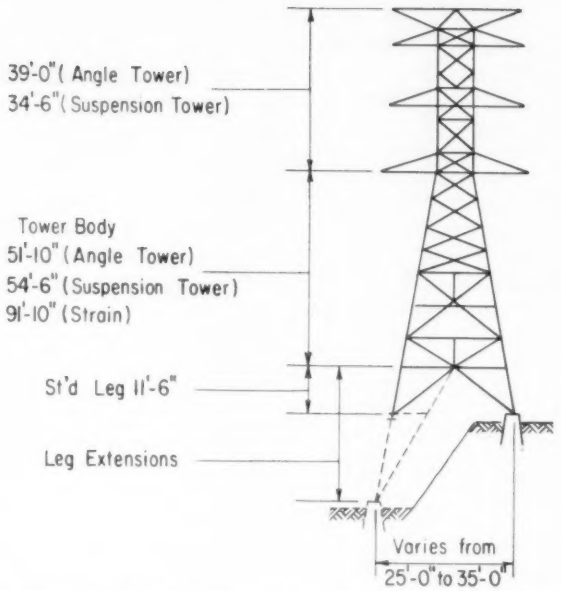
Type E—Extra heavy strain towers for 35 to 90 deg and for terminal towers.

Investigation indicated that foundations had to be designed for these soil conditions: Rock; firm ground; firm ground with some muskeg; soft ground, fine sand, and sandy gravel; muskeg as deep as 5 ft; muskeg 5 to 15 ft deep; and, muskeg deeper than 15 ft. The most practical method of constructing the 58 tower foundations in deep muskeg was to use the frozen muskeg to support construction equipment.

Accordingly, winter concreting specifications were set up, requiring the use of insulated forms and heating systems for proper curing. Scheduling and supervision were worked out to permit construction forces to install necessary equipment and to move from one site to the next as speedily as possible.

Design drawings for the foundations covered all possible conditions for each tower type. Where practicable, the footing was to be the simple auger type with an undercut bell at the bottom. The contractor hoped that this type could be used for many footings.

But, in what was thought to be suitable soil, the auger type footing proved impracticable and had to



TYPICAL STEEL TOWER specified for 138-kv transmission line used footings designed for various soils

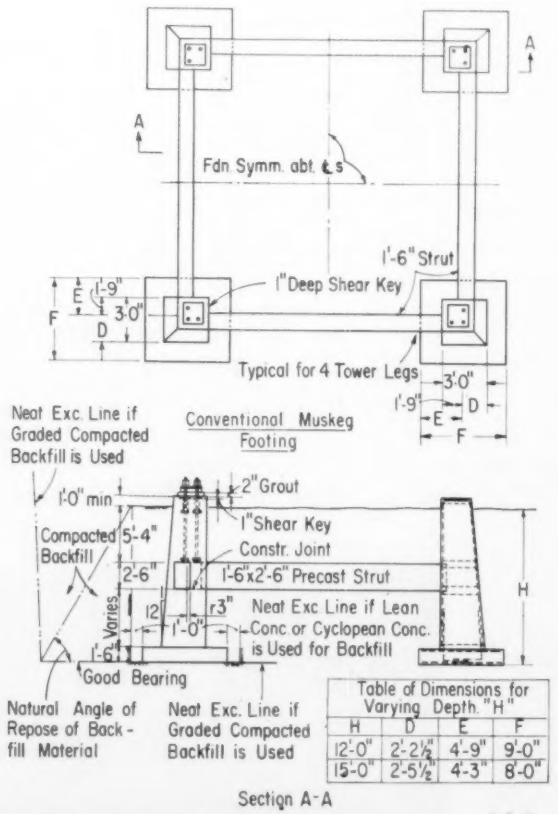
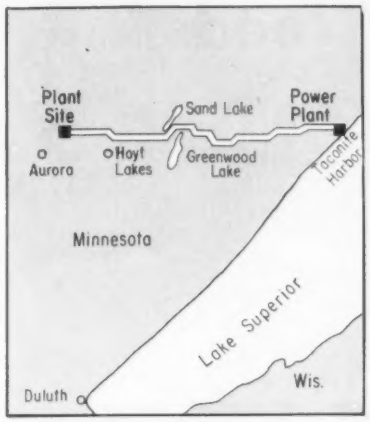


Table of Dimensions for Varying Depth "H"			
H	D	E	F
12'-0"	2'-2½"	4'-9"	9'-0"
15'-0"	2'-5½"	4'-3"	8'-0"

THIS IS THE CONVENTIONAL footing design used in muskeg. Dimensions for depth vary with bog depth

Footings



TRANSMISSION LINE joins taconite plant with power station

Type	Design Assumptions	Application	Remarks
VI	30° Assumed ∠ of soil resisting uplift; Undisturbed soil	To be used in clayey soils where it is possible to drill stem and bell without cave-in	Soil density for uplift assumed 100 #/cu.ft. for dry sites 60 #/cu.ft. for wet sites. Loss of weight in concrete due to buoyancy also considered.
VII	Compacted backfill-12" layers; 25° ∠ of soil considered to resist uplift	To be used in all soil where Type VI is not applicable where good bearing can be reached within a maximum depth of 20'	
VIII	Compacted backfill-12" layers; 25° ∠ of soil considered to resist uplift	To be used if more economical than Type VII.	
IX	1250 cu.ft of solid rock assumed to resist uplift	To be used in solid rock only	Use Type VII or VIII for laminated rock

DESIGN AND CONSTRUCTION DATA on transmission line tower footings are summarized above for other than muskeg conditions

be abandoned. Inspection of the augered hole showed that the undercut caved in.

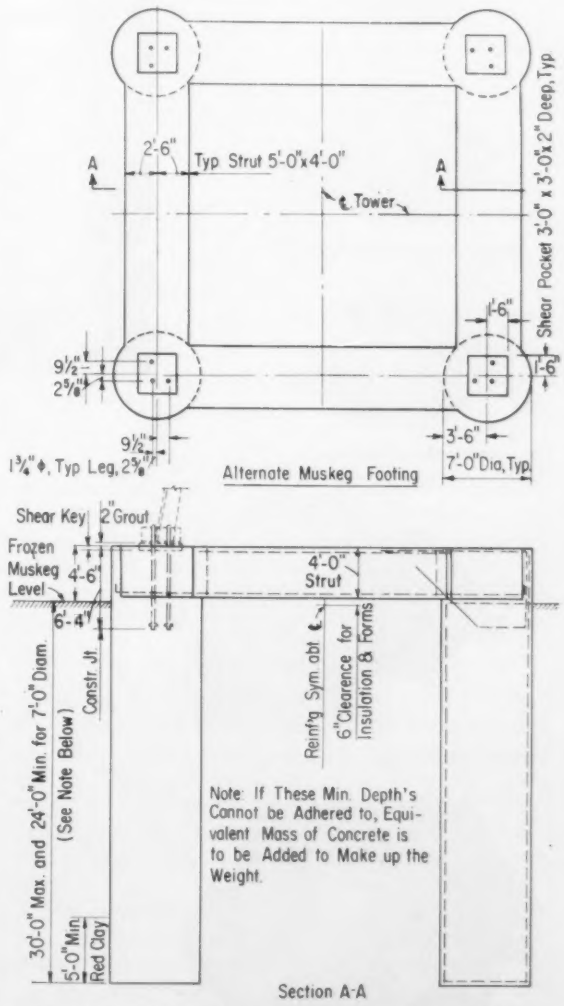
The design for the footings in deep muskeg started with the conventional foundation. This design required sheet piling and the excavation of large volumes to permit placing of proper backfill in natural slopes which could sustain horizontal forces since muskeg, from the structural point of view, is a fluid. This procedure, it was recognized, would be very costly and an alternative type was developed.

This alternative type was essentially a four-legged, two-way rigid frame consisting of circular legs which could be poured in steel forms when the frozen muskeg had been augered through. Reinforcing cages were pre-assembled above ground and lowered into the steel forms. Tremie concrete was then placed up to a short distance above the ice, the dowels being left protruding.

Above ground, insulated forms were constructed, and horizontal beam struts of reinforced concrete were poured to connect the four legs. Forms were then closed over and the heating equipment started. Inspection access was provided for the accurate recording of temperatures during concrete curing.

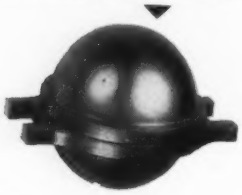
This scheme achieved reasonable speed at a considerable saving over the cost of the conventional footing, and the foundation thus established was capable of resisting all of the overturning and lateral forces, as it rested on solid bearing strata with no dependence on the treacherous muskeg.

Except for the design and fabrication of the steel towers by Bethlehem Steel Co, the entire design of the transmission line and supervision of all construction was handled by Anaconda-Jurden Associates, Inc., of New York. Soil data explorations were conducted by Dames & Moore, also of New York. Hallet Construction Co of Minnesota constructed the foundations, erected the towers, and strung the transmission line.

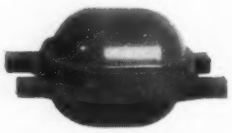


ALTERNATIVE DESIGN in muskeg is four-legged, two-way rigid frame. Round legs are poured when muskeg is frozen

With these elements . . .



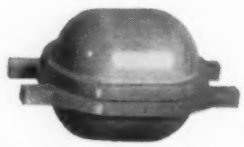
Super Pressure



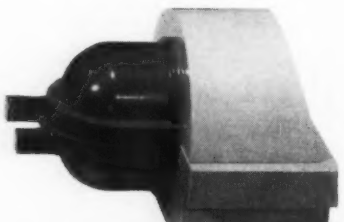
Very High Pressure

High Pressure

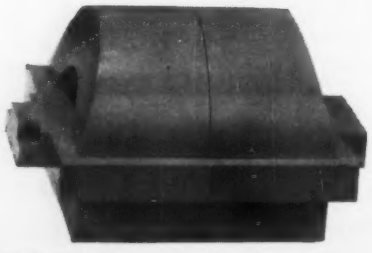
High-Medium Pressure



Intermediate Pressure



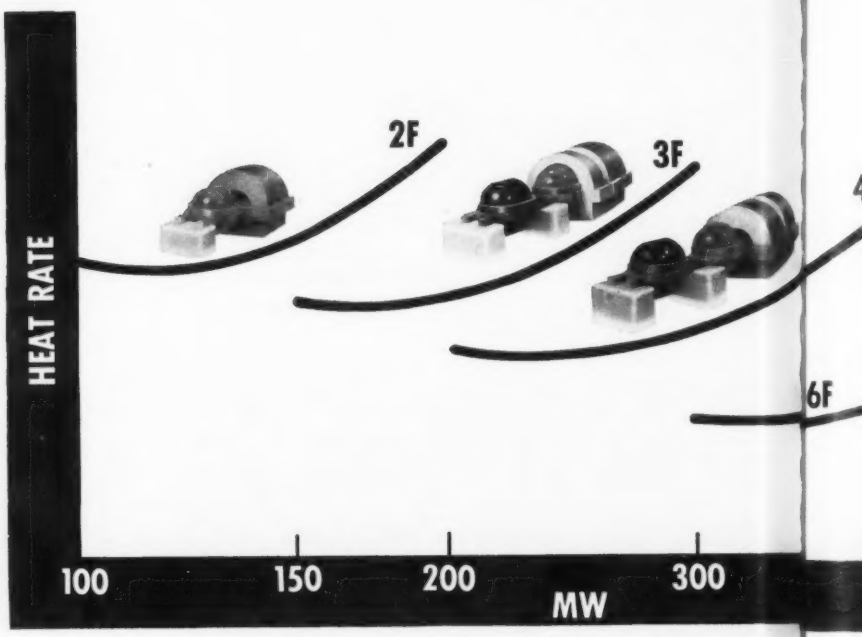
Intermediate-Low Pressure



Low Pressure

Turbine 'Building Blocks' Meet Future Needs

Modular design gives high reliability and low heat rate for wide range of unit sizes, also speeds manufacture

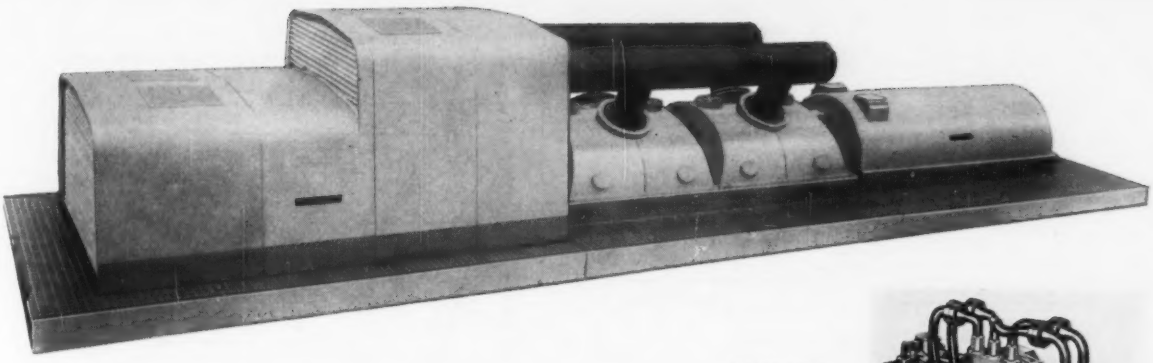


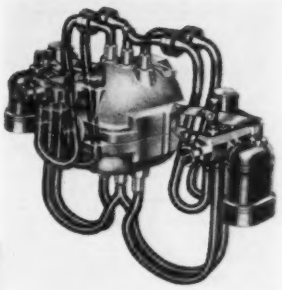
H. R. REESE, Manager, Advanced Design, Large Turbine Engineering, Westinghouse Electric Corp

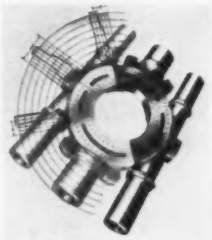
Advance planning and development of large turbine elements will lead to greater engineering research, better manufacturing reliability, and ability to meet the expected demand for electric power capacity. Success in meeting industry requirements depends upon how skillfully new or advance designs are planned, as well as improvements to existing designs.

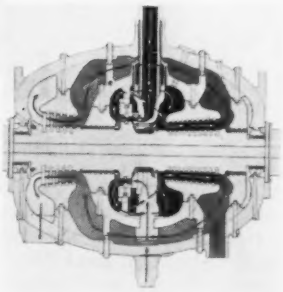
Basic elements for this modular design will include the fundamental philosophy of today's high pressure and temperature designs with separate nozzle chambers, separate stop-throttle valves, separate steam chests, and effective use of mass flow cooling. Operating experience has proved these concepts not only satisfactory but necessary since they were first applied over ten years ago. In addition the basic elements will incorporate more recent improvements.

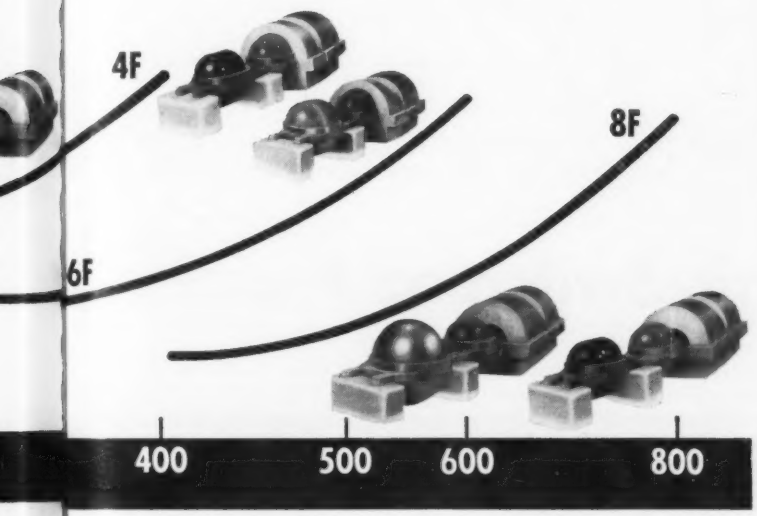
In setting up the line of basic elements, great stress has been given their place in various turbine arrangements. These pre-engineered turbine ele-











ments can be assembled like building blocks in almost any combination, from tandem-compound, double-flow units to cross-compound, octuple-flow units, and for ratings from 100 to 800 Mw. Capacity of the units is increased by adding low-pressure elements (exhaust area). The performance curve for each 3,600-rpm arrangement shows the range of ratings covered by that combination. Heat rates show improvement corresponding to the increase in capacity for each combination.

Setting up a line of basic elements involves three major considerations. These are: (1) The range of steam conditions; (2) The range of turbine ratings; (3) The turbine arrangements for which the elements will be used. For example, the high pressure element has been designed for steam conditions from 1,800 psig, 1,000F to 2,400 psig 1,050F; it will be applied in tandem-compound, triple-flow, tandem and cross-compound quadruple flow, and cross-compound double-flow 3,600/1,800-rpm turbine arrangements to cover ratings from 175 to 325 Mw.

Considering all of these requirements collectively has permitted ordering many duplicate sets of major castings, such as outer and inner cylinders, nozzle chambers, and gland cases. A composite spindle forging will act as a backup for many units. The purchaser gains in shorter and more reliable delivery schedules because the inherent backup of major parts will virtually eliminate lost time due to defective material.

Philosophy Applied Broadly

This philosophy is applied today to the complete line of basic elements. The 3,600-rpm, low-pressure element provides tremendous opportunity for duplication. These elements offer new design based on the latest advance in the art. Very active air flow model studies, directed at all portions of the turbine through which steam must pass support this program.

The program has been developed to help meet the growing needs of electric utilities in an orderly manner. Acceptance of the "building block" concept will permit more effective use of technical and manufacturing facilities, and manpower. Resulting gains in production efficiency could minimize price increases.

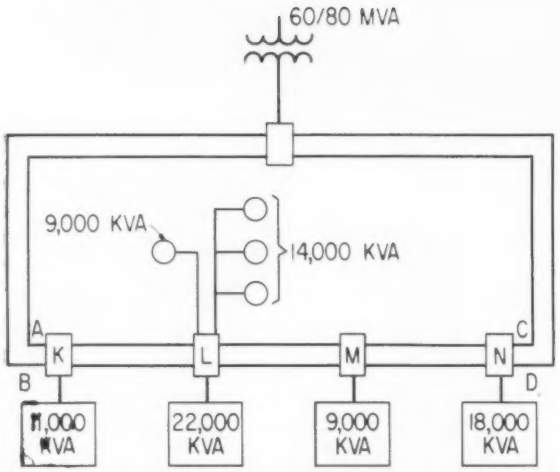


FIG. 1. FIRST STEP IN OVERLOAD reduction is to separate buses M and N. Electrical center of system is bus L

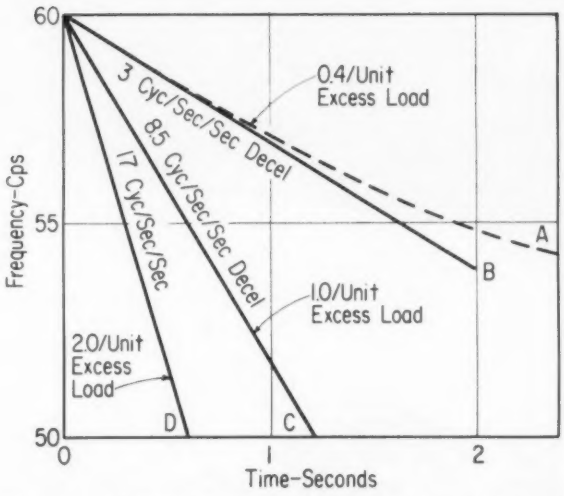


FIG. 2. RATE OF FREQUENCY CHANGE is shown for typical load inertias, constant torque load and steam pressure

Logic Static Switching Promises Be

A complex industrial power system finds itself the victim of compromises in conventional protective relaying. If the relays are set so that expensive cable circuits are protected within their safe time-temperature ratings, they will be so tight that the system will probably fall apart with minimum but frequent transient disturbances. If relays are backed off to provide maximum integrity for the even more expensive processes, protection of the cable circuits is in the "maybe" range. The engineer responsible for these selections always finds himself second-guessing the network. Through the use of sensitive, adjustable sensing devices, the logic decision control provides optimum protection for all parts of the power system.

F. K. FOX, Application Engineer, General Electric Co, San Francisco, Cal, and **R. A. WISE,** Electrical Engineer, Bechtel Corp, Refinery & Chemical Div, San Francisco, Cal.

A logic static switching system that provides instantaneous load control proved to be the solution to a difficult system protection problem in a large, complex refinery power system. Installed on a 60-mva load, with both utility supply and local generation, it provides protection against:

1. Overload in one or more feeders

2. Loss of one or more feeders

3. Total loss of utility power, with or without full generating capacity

4. Any combination of these factors.

The system is sensed continuously to detect any of these conditions. Logic decisions are made within 2.5 cycles. Except for underfrequency, the time delay between the logic and control sections will wait for any disturbance that should be cleared by the power system protective relays. Short time delay between load shed steps allows time for the system to stabilize so that overshoot is minimized.

Several years ago, when the refinery load was half its present size, a severe system disturbance, accompanied by frequency reduction, was detected only by the exceptional alertness of an employee. With the subsequent growth of the system, the real time for operation decisions decreased beyond human ability to react. Because of the speed and reliability required, the wiring complexity, space limitations, and the probable debugging difficulties, a solution using electro-mechanical relays seemed impossible, while solid state or magnetic core devices provided a powerful and versatile tool.

The present power system, Fig 1, consists of four incoming feeders from one source, four buses, six tie lines, and four generators. Refinery operating policy requires that all tie lines and incoming breakers be closed, so that the network is normally interconnected. Approximately 23 Mva of the total 60-Mva load is supplied by four local generators. Since the electrical center of the system is approximately Bus L, 40% of the load is supplied by feeders A and B, each rated 10 Mva and 60% by feeders C and D rated 17 Mva each.

From a study of the curves in Fig 2 and 3, it is apparent that when local generation is subjected to any considerable overload, corrective measures must be taken quickly and automatically to avoid disastrous random shutdown. Experience shows that low frequency accompanies practically all system disturbances

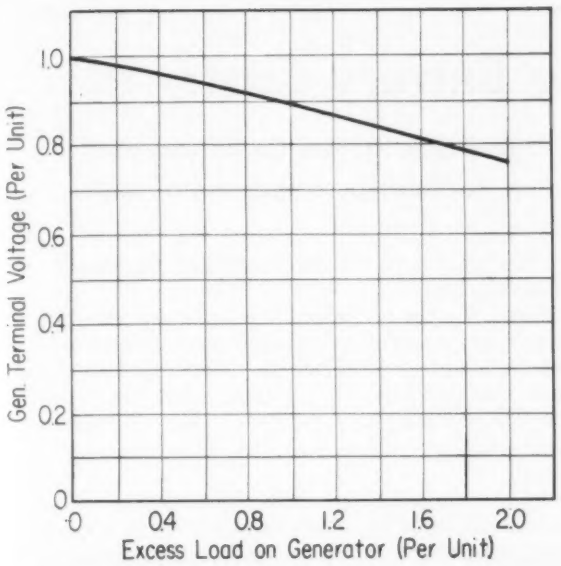


FIG. 3. **GENERATOR VOLTAGE** decreases with time because of reduced frequency. Regulator tends to hold up voltage

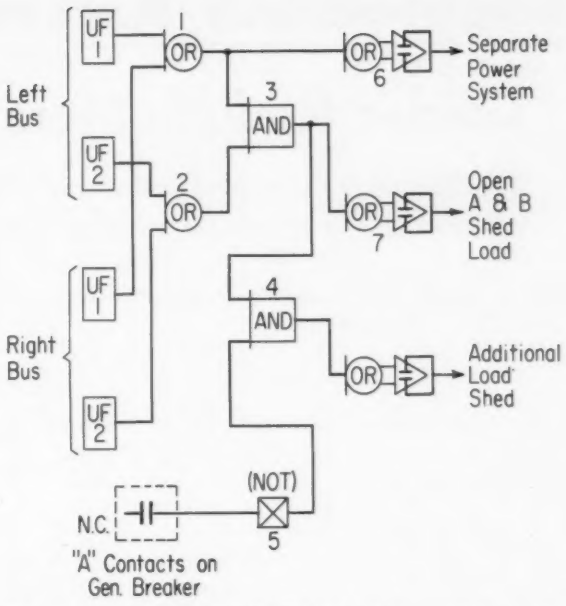


FIG. 4. **LOGIC STATIC SWITCHING** is binary system, operating in discrete steps, to protect against loss of utility supply

es Better Industrial Load Control

which result in load interruption. This is true both for small industrial systems which lose a utility feeder and for large integrated power systems. Rapid operation of appropriate breakers in the system can provide separation and/or load shedding, bring load into balance with generating capacity, and minimize the process disturbance.

Governor Lag Speeds Change

Curves B, C, and D in Fig 2 give a reasonable indication of the rate-of-change of frequency plotted against time when a steam turbine generator is subjected to various per-unit excess loads. These are approximate curves, based on typical load inertias, constant torque load, no governor lag, and constant steam pressure. Lag in governor response will increase the rate of change. A load with varying torque may unload the generator and decrease the rate of frequency change. This last contingency is quite possible in a refinery, where so many loads are centrifugal pumps or blowers whose torque varies as the square of the speed. Direct displacement pumps and compressors are constant torque loads. Lighting and electrical heating are quite likely to represent constant torque loads.

Fig 3 shows the generator terminal voltages after the sudden application of various excess loads. Terminal voltage will decrease with time because of reduced frequency.

(*Continued on page* 201)

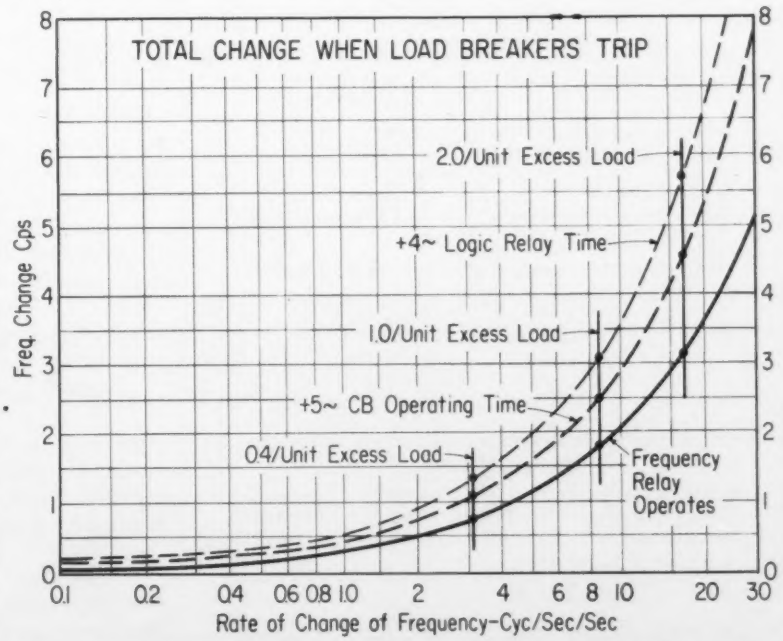


FIG. 5. **FREQUENCY CHANGE** beyond frequency relay setting, includes relay, breaker, and static switching time. Constant frequency change is assumed

Guides Reduce Storage Battery Costs—III*

To determine the annual cost of batteries, Gulf States Utilities Co has adopted several guides for proper selection and sizing, facilitating comparison of costs

LEROY J. BODEMAN, Equipment Application Engineer, Gulf States Utilities, Beaumont, Texas

How to Determine the Annual Cost of a Battery

Battery	X	Y
1. Rating—8 hr, amp	126	120
2. Manufacturer's service life, yr	8–10	14–20
3. Anticipated service life, avg yr	9	17
4. Cost of battery, $	1650.00	2418.00
5. Cost of rack, $	181.00	181.00
6. Installation cost, $	200.00	200.00
7. Installed cost (battery & rack), $	2031.00	2799.00
8. Est net salvage at retirement, $	50.00	50.00
9. Depreciable investment, $	1981.00	2749.00
10. Est annual operating cost, $	100.00	100.00
11. Est taxes other than income (1% of cost), $	20.31	27.99
12. Return on investment @ 6%, $	121.86	167.94
13. Depreciation annuity @ 6% compound interest, $	172.39	97.42
14. Income tax deductions		
Expenses, $	100.00	100.00
Other taxes, $	20.31	27.99
Depreciation, straight line, $	220.11	161.71
3.25 on 50% of investment, $	33.00	45.48
Total income tax deductions, $	373.42	335.18
15. Income tax, $	46.40	65.60
For 9-yr battery		
Revenue = Steps 10 + 11 + 12 + 13 + income tax		
= $414.56 + income tax		
Income tax = 53% (Revenue − Deductions)		
= 53% ($414.56 + income tax − $373.42)		
= $219.72 + 53% income tax − $197.91		
= $46.40		
For 17-yr battery		
Revenue = Steps 10 + 11 + 12 + 13 + income tax		
= $393.35 + income tax		
Income tax = 53% (Revenue − Deductions)		
= 53% ($393.35 + income tax − $335.18)		
= $208.48 + 53% income tax − $177.65		
= $65.60		
16. Break-even annual revenue, $ Steps 10 + 11 + 12 + 13 + 15	460.96	458.95

RESULT—The 17-yr battery is $2.01 less expensive than the 9-yr battery.

Comparison of Long and Simplified Formulas for Battery Costs

Annual Cost Method	9-Yr	17-Yr	Difference
The long formula, $	460.96	458.95	2.01
Simplified formula, $	465.34	463.33	2.01

This guide is to aid the Purchasing Department in evaluating bids.

After the type of battery is selected for an application, the engineer determines the sizes of each manufacturer's battery of that type. Then the Purchasing Dept obtains quotations for those particular types of batteries—no substitutes permitted—and compares the annual cost of each to arrive at the most economical battery.

By the foregoing procedures, two batteries may be economical in some substations. When two batteries are used, usually the large momentary currents for breaker tripping and the continuous currents for carrier channels and indicating lamps are supplied by a lead-acid battery; supervisory equipment is served by a nickel-cadmium battery.

The Purchasing Dept uses a method for comparing annual costs of batteries having different life expectancies. This method has been simplified to a formula, to obviate detailed calculations. A comparison of both is given. In using this formula the company has concluded that:

1. About 12.5% more can be paid initially for a 10 to 12-yr battery than for an 8 to 10-yr unit.

2. About 39.5% more can be paid for a 16 to 20-yr battery than for an 8 to 10-yr unit.

3. About 50.8% more can be paid for a 25-yr battery than for an 8 to 10-yr unit.

4. About 24% more can be paid for a 16 to 20-yr battery than for a 10 to 12-yr unit.

Simplified Formula for Annual Cost of Battery

Because items 10 and 13 are not percentages of the total cost, they are added separately. However, items 11 and 12, which are percentages, can be combined. Numerous calculations of item 15 show it to be about 2.5% of the installed cost, so this is added to items 11 and 12, resulting in the following formula:

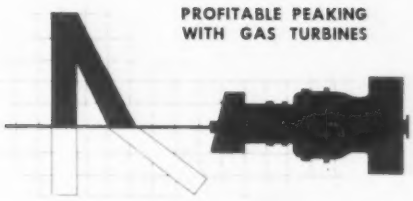
Break-even annual revenue
= 0.095 installed cost + depreciation annuity + annual operating costs

Recalculating the cost of the two batteries using this simplified formula gives:

For 9-yr battery
Break-even annual revenue
= 0.095 (2031.00) + 0.08702 (1981.00) + 100.00
= $465.54

For 17-yr battery
Break-even annual revenue
= 0.095 2799.00) + 0.03544 (2749.00) + 100.00
= $463.33

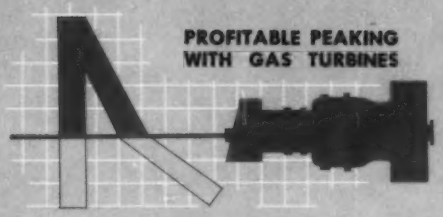
* Part I—"Application Engineering of a Lead-Acid Battery" and Part II—"Application Engineering of a Nickel-Cadmium Battery" appeared in Electrical World, June 1, 1959, p. 86, and June 15, 1959, p. 59, respectively.



NEW General Electric Gas Turbine Specifically Designed For Economical Peaking Applications

GENERAL ELECTRIC

◀ FOR COMPLETE DETAILS, FOLD OUT



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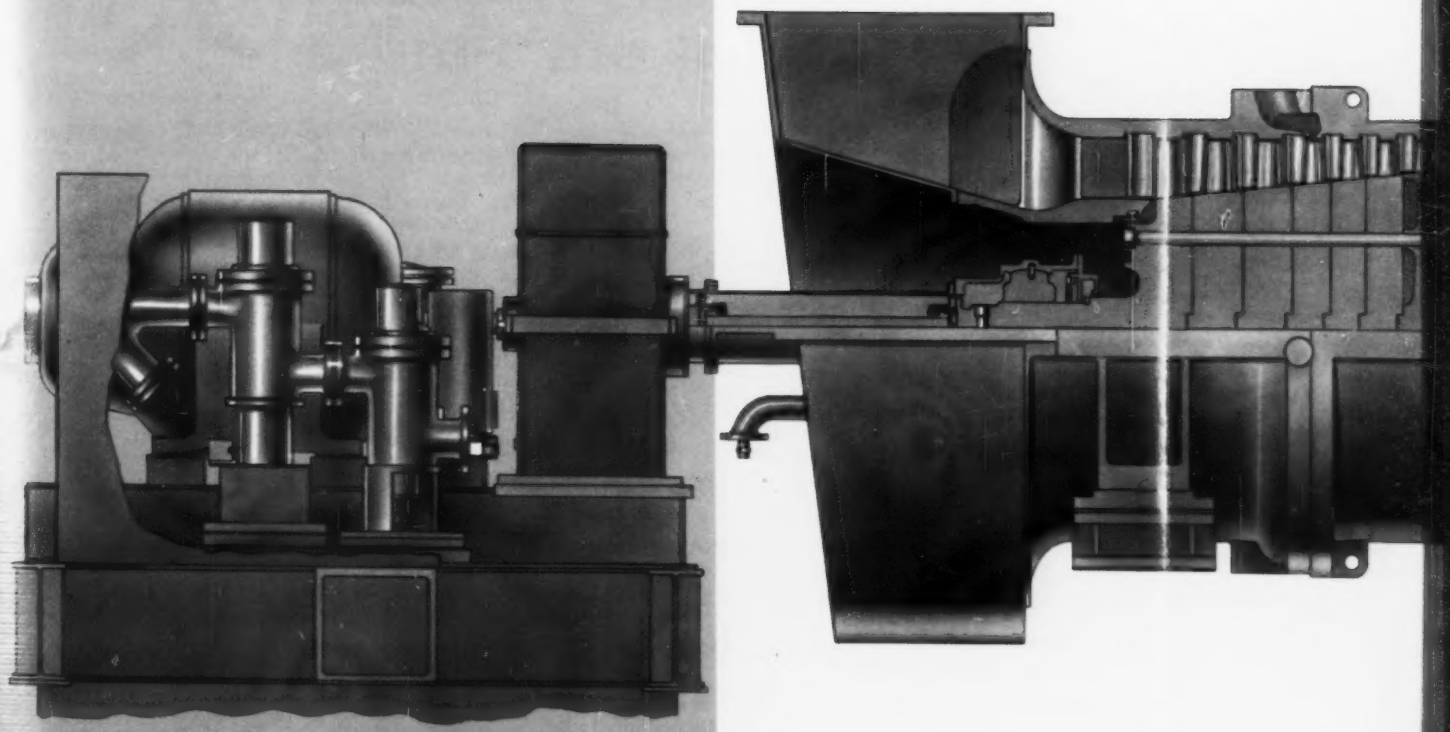
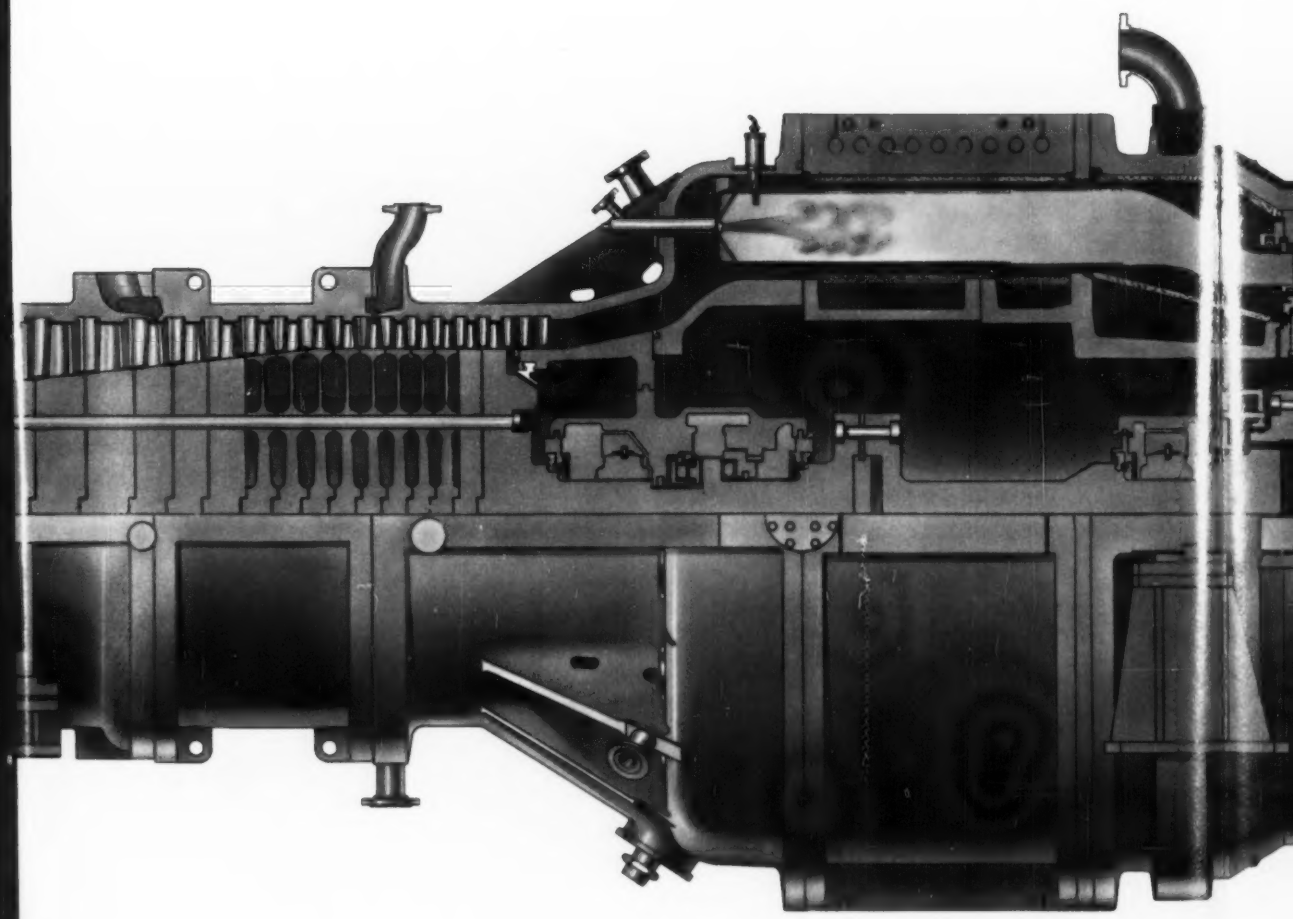


The NEW 20,000-25,000

Single-shaft General Electric G



000 Kw Simple-cycle,
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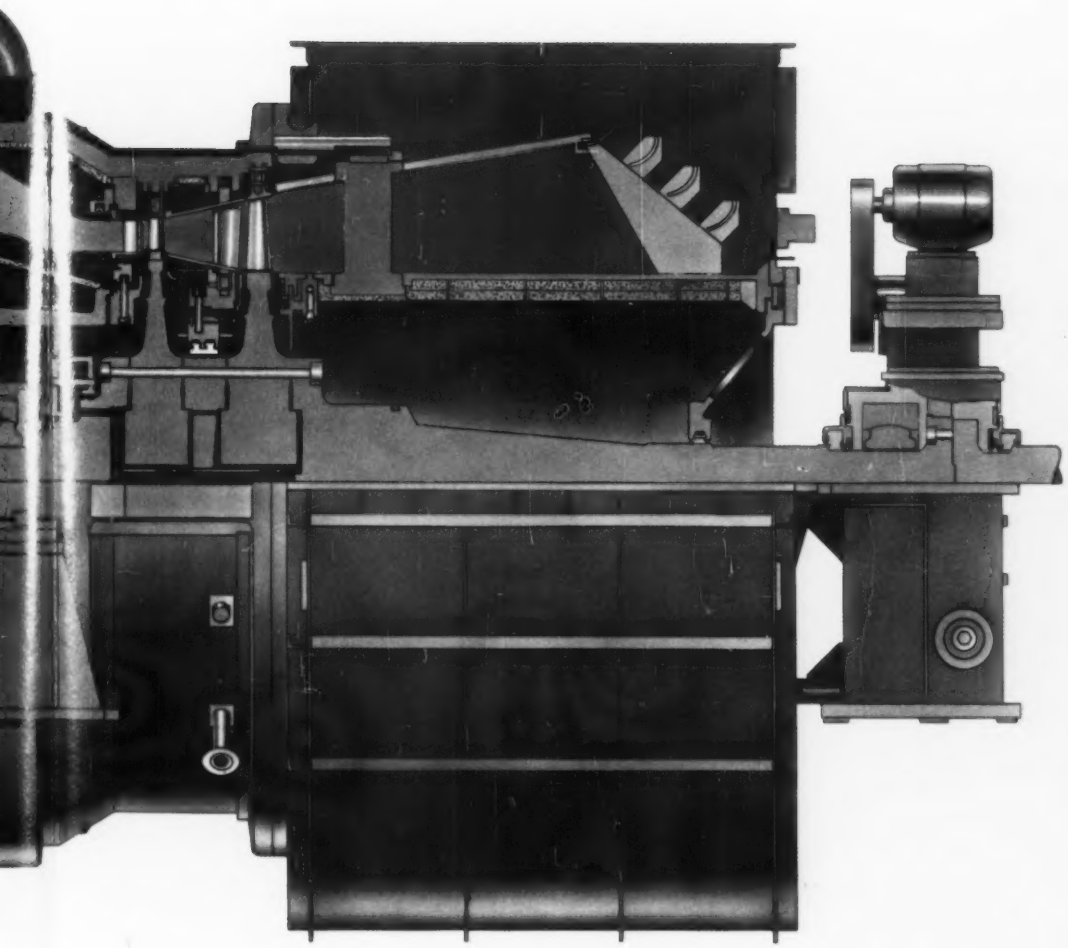


GENERAL ELECTRIC

HERE ARE IMPORTANT REASONS WHY . . .

General Electric Gas Turbines Offer The Economical Answer To Varied Peaking Requirements

LOWER INSTALLED COSTS

Depending on the specific application, General Electric gas turbines install for $110 to $130 dollars per kilowatt and can save up to $50 dollars per kilowatt in additional system investment. Low space requirements, minimum foundations, simple building requirements, flexibility in site location, and basic design simplicity lower initial investment expense.

LOWER OPERATING COSTS

Lower operating labor, maintenance and standby costs all contribute to reducing operating expenses. Gas turbines require no attendance or auxiliary service during periods of inoperation. Total fuel costs are low because of the short duration of peak loads. Lube oil consumption is negligible. No deterioration takes place while the unit is not operating.

HIGHER RATINGS IN ONE UNIT

General Electric's peaking gas turbine is designed to produce 20,000-25,000 kilowatts. Larger units are planned to keep pace with system load growth. Because one gas turbine of this size produces over 10 times more kilowatts than simple building block units, space, installation and maintenance costs and control complexity are reduced.

LIMITED SPACE

General Electric's 20,000-25,000 kilowatt gas turbine is a compact, self-contained unit 67 feet long, 15 feet wide and 10 feet high. Only a small, inexpensive building is required. A typical station is only 15,000 square feet. This includes all station services, auxiliaries, switchgear, transformers, and controls.

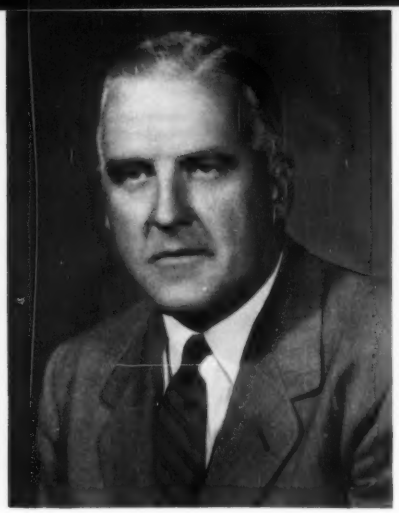
SIMPLE, FAST START-UP

Starting takes less than 20 minutes. Starting sequence is initiated by a single control switch in the supervisory control panel.

MINIMUM PERSONNEL

Due to their extreme simplicity, compact arrangement and easy-to-use controls, and auxiliaries, General Electric gas turbines require a minimum of personnel. Easily adapted features also permit automatic starting and remote operation. When installed at existing steam plants, additional labor is usually not required.

GENERAL ELECTRIC



A Statement by **W. S. Ginn**
Vice President and General Manager
Turbine Division,
General Electric Company

Gas Turbines Hold Greatest Promise of Meeting Extensive Utility Peaking Needs of the Future

After extensive study the General Electric Company has concluded that low-investment gas turbines provide the greatest promise of answering electric utility peaking requirements of the future.

Rapid Peak Load Growth in recent years has focused new interest on the costs incurred for providing added peak load capacity.

Historically, expansion of system capacity has been accomplished by adding large steam turbine power plants to serve the base load portion of the system and operating older power plants at progressively lower load factors until they are retired. However, today on many electric utility systems much of the generating capacity is provided by steam turbine power plants nearly as efficient as the latest equipment.

A continuation of this trend means that today's more costly high-pressure reheat steam plants will become tomorrow's peaking units. Gas turbines, offering appreciably lower initial cost than comparable steam turbine stations provide the economical solution to this basic change in peak load generation economics.

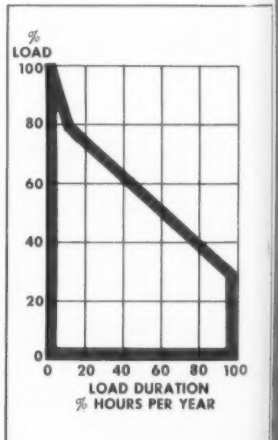
Briefly, Here's Why. General Electric gas turbines offer high capacity from one self-contained unit. In sharp contrast to small building block units, General Electric offers a gas turbine producing 20,000-25,000 kilowatts. Capacity growth potential for the future is inherent in their design.

Lower initial investment results from low space requirements, small foundations, simple building requirements, low cooling-water requirements, and basic design simplicity.

Lower total operating costs result from lower initial investment, reduced maintenance, low standby cost, negligible lubrication oil requirements, and the minimized operating labor costs inherent in automatic or remote operation.

Gas turbines are ready—now—to fill your growing peaking requirements. With 189 General Electric units now in service logging a total of nearly 3,000,000 operating hours, these proved prime movers stand ready to assume their rightful role in helping meet tomorrow's growing peaking power demands—economically.

For More Information, contact your nearest G-E Apparatus Sales Office or write Section 261-34, General Electric, Schenectady 5, New York.

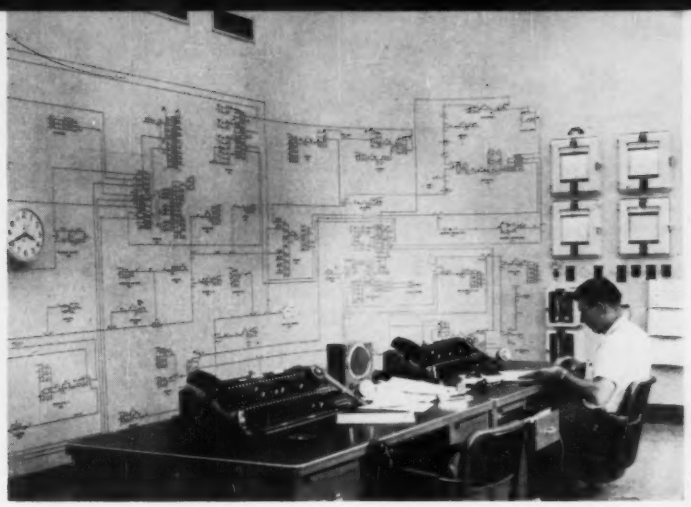


WITH THE TOP TEN PER CENT of system load having a duration of only a few hundred hours annually, gas turbines offering lower initial investment costs are General Electric's answer to peaking power requirements of the future.

Progress Is Our Most Important Product

GENERAL ELECTRIC

ORIGINAL ILLUMINATION was warm white, cold cathode fluorescent lamps. Board was painted a light shade of tan



AFTER RENOVATION, board was extended to ceiling and repainted gray. Lighting was changed to daylight lamps

Improve Lighting for Dispatchers

TVA provides more effective lighting for load dispatching offices by paying close attention to visibility details

S. C. **KYLE,** Occupational Health Branch, Division of Health and Safety, Tennessee Valley Authority, Wilson Dam, Ala.

B. H. **MARTIN,** Division of Power Utilization, Office of Power, Tennessee Valley Authority, Chattanooga, Tenn.

TVA improves visibility in load dispatching offices up to 450% by careful attention to lighting details. Color, size and design of identifying numerals, contrast, quality of lighting and dispatchers' viewing distances are considered, in addition to illumination levels.

Dispatching offices are provided with a diagram board showing power transmission features of the system for a given area. The diagram is of the single-line type formed by dull finish, colored tape. Specific colors designate voltage ranges, and die-cut symbols are used for transformers and other equipment.

The board consists of a semi-elliptical steel panel extending from floor to ceiling. The major radius approximates 20 ft; this represents the maximum distance at which a dispatcher seated at his desk must read accurately and quickly the identifying numbers and symbols.

Particular attention is given the light around the periphery of the board from ceiling to floor. At some locations, tapering of light strength in decreasing intensity from board to opposite wall is used. Thus, light on the board and meter charts is emphasized without exceeding the accepted range of brightness levels in various parts of the room. Illumination is such that adequate visibility of the diagram board means adequate illumination of the charts.

Visibility of black numerals on the diagram board varies with the color of tape with which they are associated even though all are in the same area. Thus, a number near a red tape differs in visibility from a number near a blue tape. Marked improvement may be gained by (1) careful selection of background board color and (2) selection of a light source that complements the background board color.

Table shows improvement in visibility at Wilson Load Dispatching Office after the principles were applied. Before the changes, the diagram board was light tan and illumination was by warm white, cold cathode fluorescent lamps. The board was extended to the ceiling and repainted and lighting changed to cold cathode fluorescent.

Painting consisted of a base coat applied to a prepared surface, a color coat of French Gray lacquer (flat), dotted grid of Shell Gray lacquer (flat), and a seal coat of clear flatted lacquer. Furniture and instruments were painted light gray.

The Luckiesh-Moss visibility meter was used to evaluate visibility on a numerical basis. It provides a quantitative index of actual seeing conditions. Meters used for most lighting surveys measure illumination only.

Summary of Improvements In Seeing Conditions

Tennessee Valley Authority, Wilson Load Dispatching Office, Wilson Dam, Alabama

Location of Measurements	Average Illumination Levels Foot Candles		Average Visibility Readings Units	
	Before	After	Before	After
Upper third of board	22	68	Less than 2.0	4.5
Middle third of board	20	59	Less than 1.5	4.8
Lower third of board	15	52	Less than 1.5	4.6
Total Board	—	60	—	4.6

Note: All measurements made at night.

THE MAN WHO HAS TO KNOW,
J. COLEMAN JONES, GENERAL SUPERINTENDENT,
TELLS WHY . . .

DEPENDABILITY pays dividends for Pacific Power & Light's investment in General Electric voltage regulators

"We use many General Electric three-phase step regulators for efficient system voltage control at the substation. Over the years, General Electric MLT-32 regulators have paid us dividends in dependable performance."

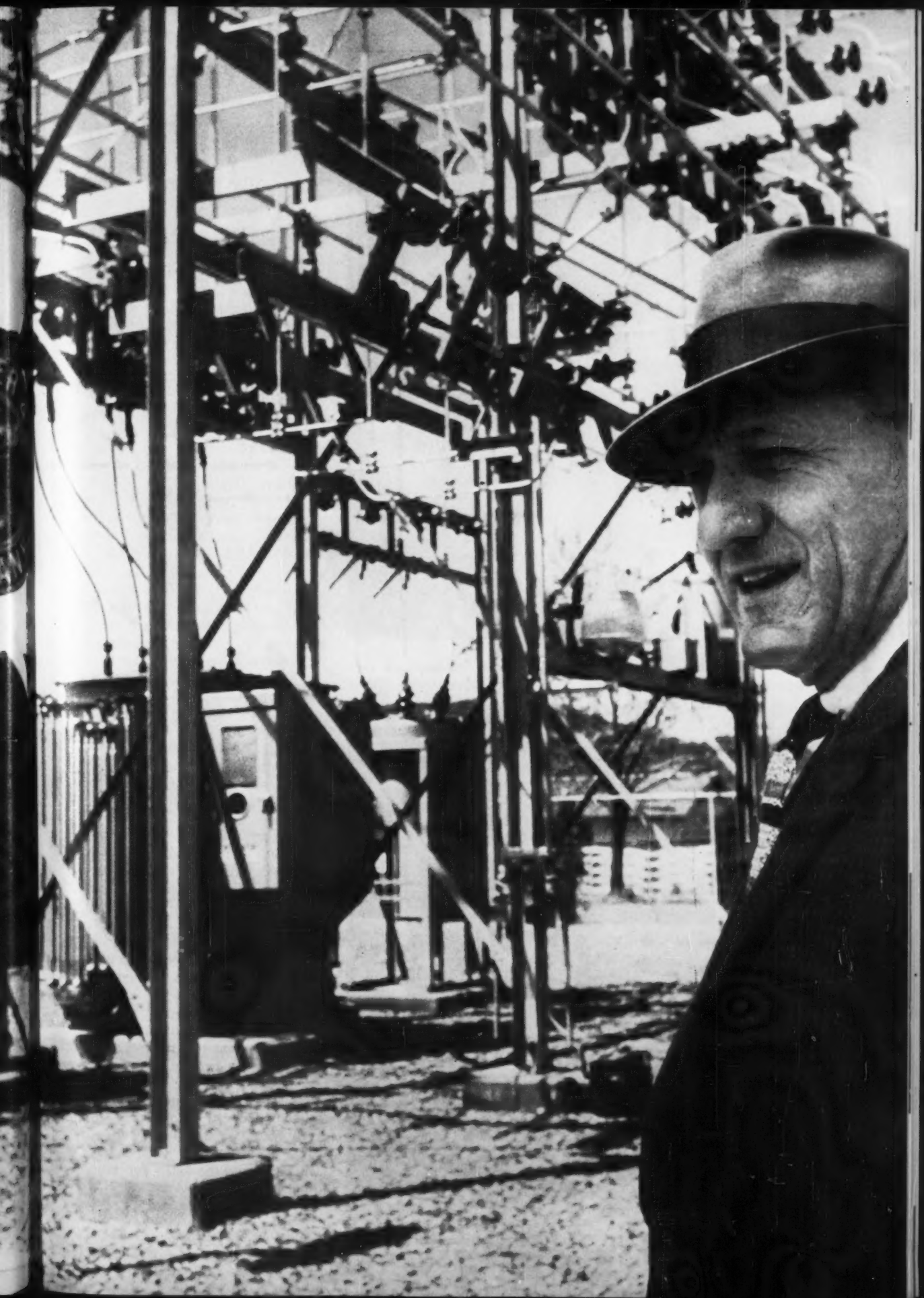
Dependability means highly-reliable equipment operation with least-possible maintenance. General Electric controlled speed switching results in fast-break, slow-make tap changes for minimum contact wear and prolonged regulator life. Hydraulic dashpots and redesigned Geneva gears reduce switching noise.

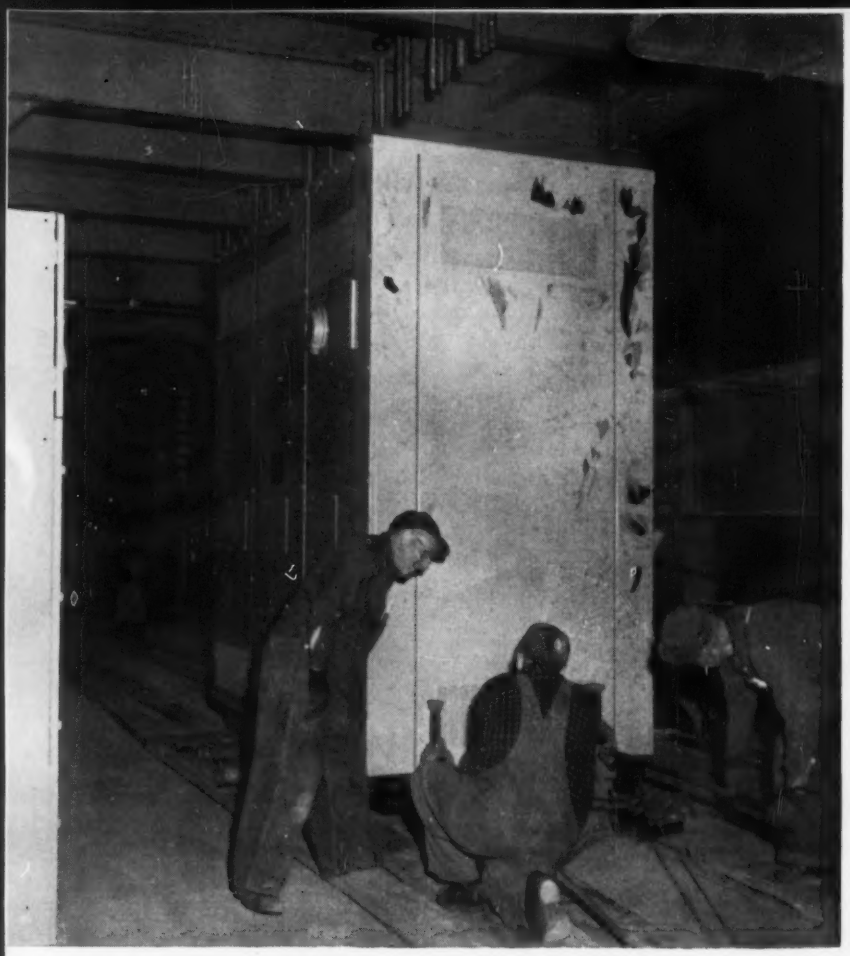
GENERAL ELECTRIC REGULATORS COST LESS ON THE LINE because you get continuing Extra Dividends . . . from **G-E DEPENDABILITY**—absolute minimum maintenance; in **G-E SERVICE**—routine or emergency; from **G-E RESEARCH**—superior regulating equipment. Result: Extra values = **LOWER COSTS.**

Only General Electric returns so much for your regulator investment. Ask your General Electric regulator representative to show you how. General Electric Co., Schenectady 5, New York. 423-39

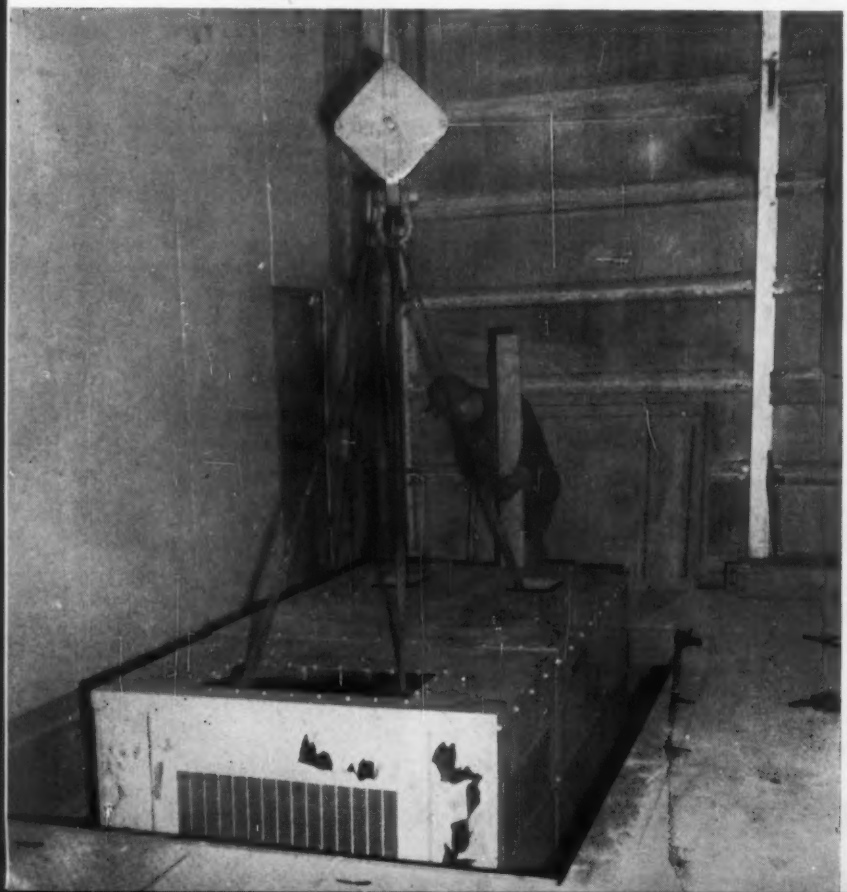
Progress Is Our Most Important Product

GENERAL ELECTRIC





DRY-TYPE TRANSFORMER of 3-phase design is compact and relatively light which permitted installation on the upper floor through a hatchway (below)



Dry Unit Simplifies Structure

B. K. KANGA, Electrical Engineer, Vern E. Alden Co, Consulting Engineers, Chicago, Ill.

A high-capacity open dry-type transformer with 3-phase construction was installed as an auxiliary transformer for Unit 5 of the Alma steam plant of Dairyland Electric Cooperative. It is a 5,000/6,667 kva, 14,400-2,400-v unit. Alma's No. 5 generating unit has a capacity of 81,600 kw.

The dry-type transformer weighs less than a liquid-filled transformer of the same capacity. As it was for an upper floor of the station, the lesser weight made possible a more economical structural design. As it was for installation on the floor above the boiler and turbine gauge board and benchboard, it was important to eliminate oil leakage. Built on a 3-phase, three-legged, vertical-type core, the design is more compact than three single-phase units in one enclosure.

Forced-air rating of the dry-type transformer is 133% of the self-cooled rating, compared to 125% for a liquid-filled transformer. All connections are internal. The lower BIL of the dry-type transformer is not a disadvantage.

The unit auxiliary transformer, the 2,400-v unit auxiliary switchgear, and the 480-v unit auxiliary substation are in a bay between the turbine room and the boiler room. Thus the 2,400 and 480-v cables from the switchgear and unit substations were kept short. The compact transformer was brought up through a hatchway in the floor.

The 2,400-v switchgear is on the floor directly above the unit auxiliary transformer. This permits a very short duct run between transformer and switchgear. The 480-v unit substation, on the same floor as the unit auxiliary transformer, is directly below the 2,400-v switchgear. Cable connections between the switchgear and the 480-v substation are also short.

Enjay Butyl is used in General Electric washers and refrigerators because it offers economy and outstanding all-round quality performance.

ENJAY BUTYL

helps make more efficient appliances!

General Electric uses gaskets and hoses made of Enjay Butyl in their new washers and refrigerators.

Enjay Butyl parts are highly resistant to heat... aging... moisture detergents, bleaches and other chemicals. As a result, equipment lasts longer, performs better.

Technicians constantly find new ways to use Enjay Butyl in a great variety of applications—*and at lower costs!* It will pay you to investigate the possibilities of this versatile rubber in *your* product. For full information and expert technical assistance, write or wire the Enjay Company.

ENJAY BUTYL

Enjay Butyl is the greatest rubber value in the world. It's the super-durable rubber with outstanding resistance to aging • abrasion • tear • chipping • cracking • ozone and corona • chemicals • gases • heat • cold • sunlight • moisture.

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YOUR BEST BUY

General Electric Master Unit Substations are your best "total value" buy—most advanced transformer, switchgear designs . . . completely integrated for modern, economical power distribution.

For a "total value" product appraisal, consider these over-all advantages of factory-built unit substations, then factor in the product superiority of G-E transformer and switchgear components.

With factory-built substations, you benefit from the work of G-E's expert engineering staff which takes over the detail jobs of substation design and frees your engineers for other projects.

Centralizing responsibility with General Electric assures you of a thoroughly integrated, modern product, like the unit substation shown at the right which supplies the entire electrical load for the new United States Gypsum Company plant at Galena Park, Texas. Single billing against one order number means simplified cost control. Coordinated shipment results in quicker, less-costly installation. Factory-built unit substations make possible a building-block approach to low-cost expansion.

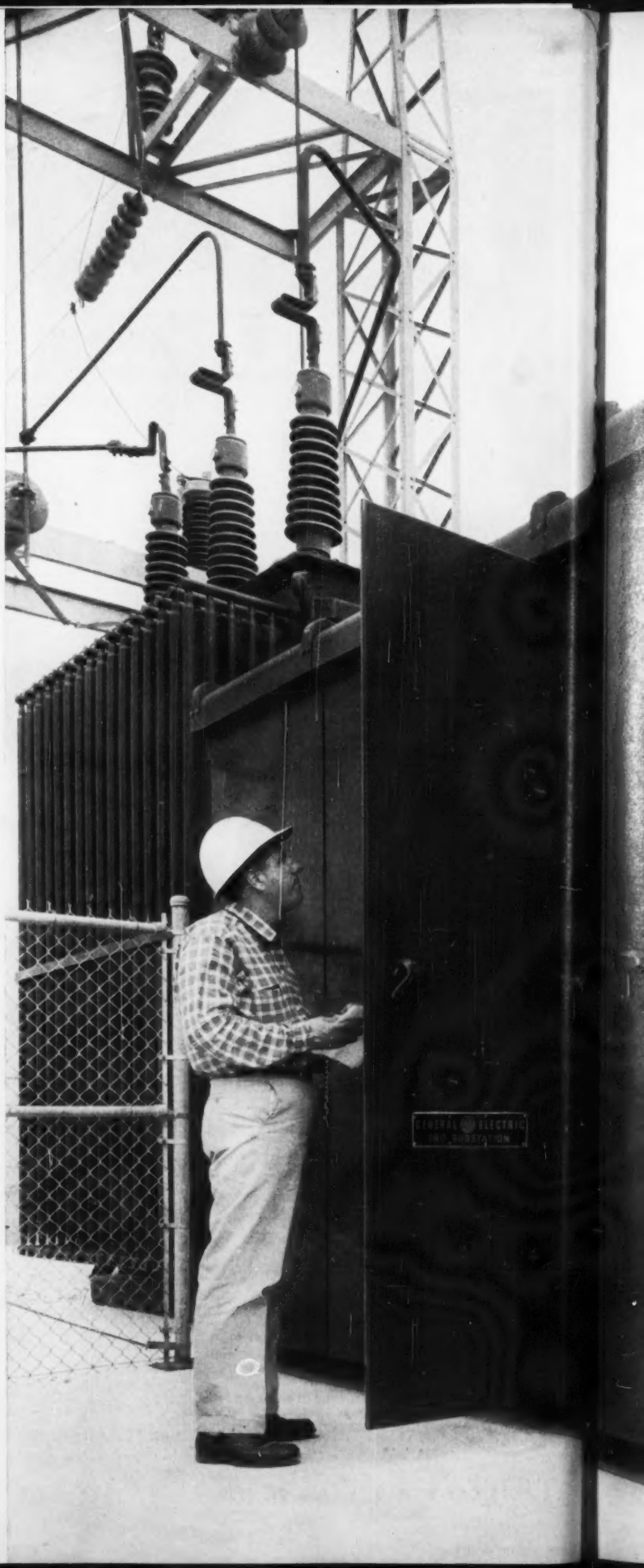
Unit substations have been accepted as community "good neighbors" because they are attractive, compact, easy to landscape, and have low noise levels.

After you make the basic determinations of station arrangement, subtransmission and feeder voltages, specify a General Electric Master Unit Substation for the best "total value" buy for your distribution system investment. For more information, contact your nearest G-E Apparatus Sales Office. General Electric Co., Schenectady 5, N. Y.

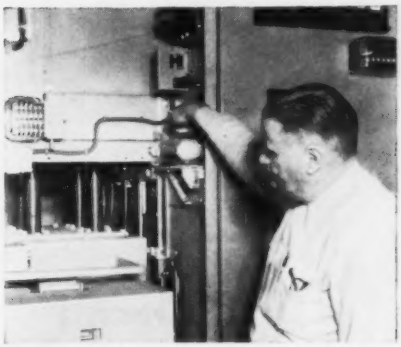
512-32

Progress Is Our Most Important Product

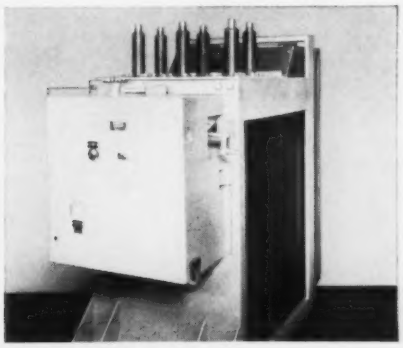
GENERAL ELECTRIC



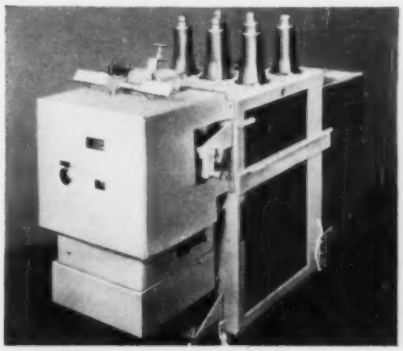
These switchgear features are part of G-E Unit Substation value



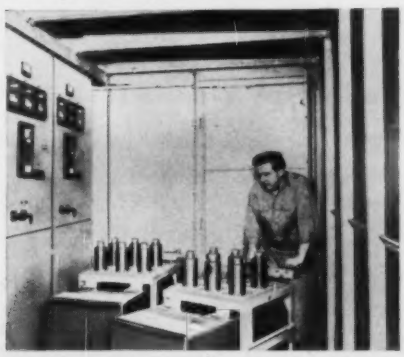
VERTICAL-LIFT DESIGN makes inspection, maintenance safer. Operators can actually see when primary disconnects are parted.



FIRST 1000 MVA BREAKER was developed to meet need for increased interrupting capacity. It makes G-E line most complete in industry.



TWO-CYCLE BREAKER offers benefit of reduced line burning during fault, better coordination with other distribution protective devices.



PROTECTED AISLE permits maintenance—indoors—in any kind of weather. An optional feature, the protected aisle is shipped factory-assembled.

Procurement & Products

FLY ASH ▶ **Savings of $40,000 a year on fly ash disposal** will be made by Cleveland Department of Light & Power under a recently signed contract. The city will sell fly ash from its municipal plant to a Philadelphia firm at 50¢ a ton—netting about $10,000 a year. Previously it has cost the city about $30,000 a year to haul the ash to a lakefront dump.

PRICES ▶ **Price reductions of 5 to 15% on street lighting units** and ballasts have been announced by Westinghouse. Lower prices apply to incandescent and small mercury lamp luminaires for residential application; higher intensity mercury units for thoroughfares and expressways; and the OV 25 "silverliner," a 400-watt mercury luminaire available with built-in ballast; and most models of mercury ballasts.

MEETING ▶ **National Association of Purchasing Agents meeting in New York in Mid-June covered subjects ranging from the purchasing philosophy to inventory control. Following are excerpts from some of the papers given:**

NEW NAME ▶ **"If purchasing needs a new title,** I am suggesting 'Supply Management,'" said George A. Renard of the Journal of Commerce. "Good purchasing executives don't grab for more power; they co-ordinate the profit possibilities of the company in supply management by becoming the center of communications for the contributing departments and executives."

FUEL ▶ **Rising prices are in store for both gas and coal,** the purchasing agents were told. C. J. Potter, President, Rochester & Pittsburgh Coal Co, said a substantial increase in the price of coal is mandatory. A price boost of even 50¢ a ton would, in fact, "be insignificant when compared with our 1948 prices or when we consider general inflation," he said.

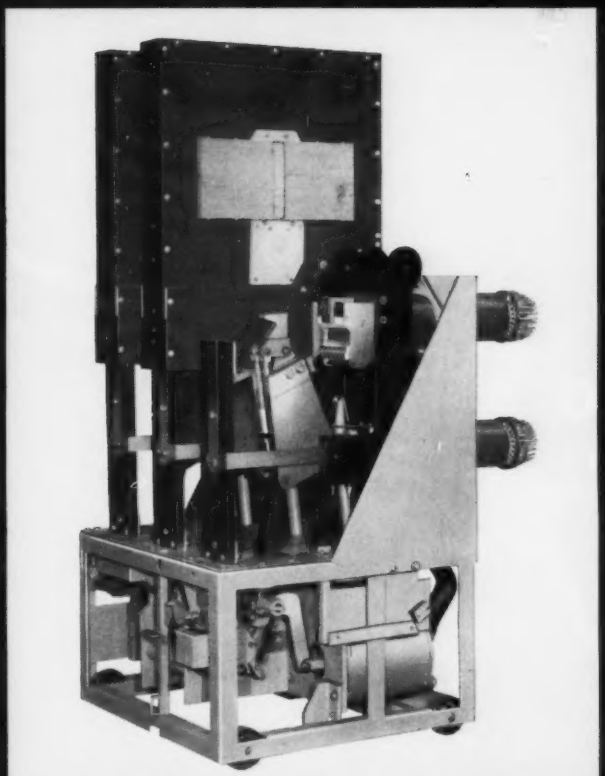
Higher gas prices are a certainty in the coming years, reported C. E. Loomis, The Columbia Gas System. Rising discovery and equipment costs along with inflation and market conditions will tend almost inevitably to force prices upward from current levels, he said.

SERVICE ▶ **"One of the most valuable services you can perform** is to make the rich technical knowledge and experience of your suppliers work for your company," said Mark W. Cresap, Jr, Westinghouse Electric Corp. "You can benefit from your suppliers' expenditures on research, development, and engineering. You can multiply your own effectiveness in proportion to their skills and facilities."

News of Manufacturers ..... page 118
New Equipment ..... page 129
Readers Service ..... page 197

Now in service...
controlling and
protecting modern
generating and
distribution systems

NEW BREAKERS BEING ASSEMBLED AND SHIPPED



Type DST 5 kv 350 mva Air Circuit Breaker 1200 and 3000 amps

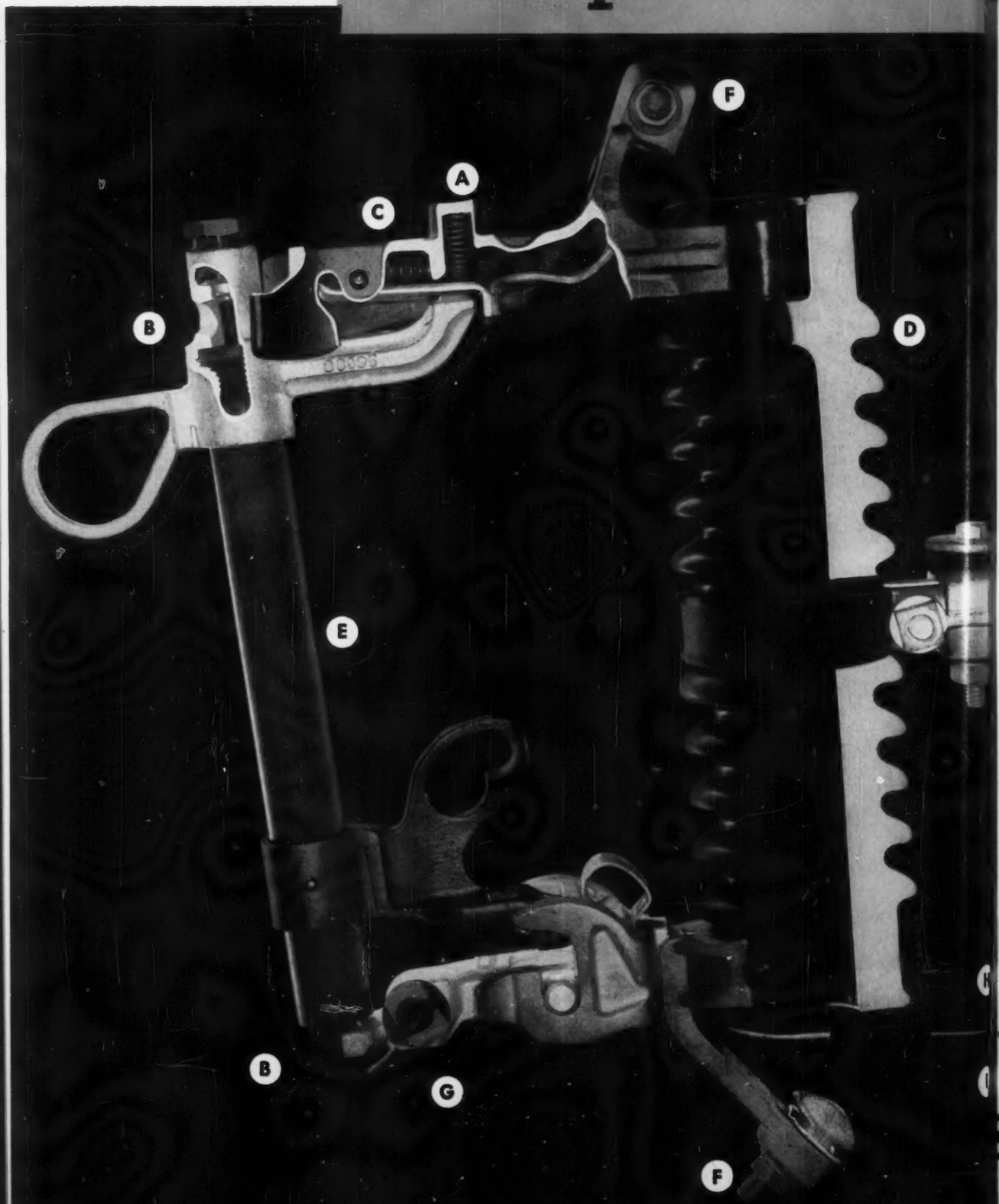
Federal Pacific's new 5 kv 350 mva Air Circuit Breaker

Your increased capacity requirements dictated its need. Our commitment to provide a complete quality line prompted its manufacture. Latest technicological advances shaped its development. Built for ruggedness, long life, ease of maintenance and inspection, it naturally meets all NEMA, ASA, AEIC and AIEE standards. Federal Pacific has created a new 5 kv, 350 mva Air Circuit Breaker of beautiful proportion, striking simplicity and masterful performance. Write for Bulletin 3-450, Federal Pacific Electric Company, General Offices: Department 259, Newark 1, New Jersey.

FPE **FEDERAL PACIFIC ELECTRIC COMPANY**

The Best in Electrical Distribution and Control Equipment

For full range fault protection...



..specify KEARNEY Type "G" Cutouts

Extensive, rugged, field operating tests prove that the Kearney Type "G" Cutout provides full protection throughout the complete range of fault currents—without use of adaptors or gadgets.

Study the advanced features that make these extra heavy duty cutouts your most logical choice for line fusing, transformer and capacitor protection.

Ask your Kearney representative to explain fully why you can count on Kearney Type "G" Cutouts for superior construction, thorough dependability and unfailing protection.

Check These Advanced Features

- **A** Full Floating Contact—stainless steel spring absorbs upward thrust, maintains contact pressure until arc is extinguished.
- **B** Gas Vents—double vent action minimizes internal gas pressure.
- **C** Horizontal Stainless Steel Spring—helps absorb recoil during fault interruption, takes shock when closing cartridge.
- **D** Insulator—designed for strength and lightness, barrier prevents internal leakage.
- **E** Cartridge—½" bore assures positive interruption of low faults; extra strength tube withstands pressure of high currents; accepts universal fuse links; no need for adaptors and other gadgets.
- **F** Terminals, Plated T-Lug Design—for use with all types of conductors.
- **G** Flipper—whip action provides 4" travel in separating blown fuse link.
- **H** All live parts non-ferrous or stainless steel.
- **I** Can be field or factory equipped with link break attachment.

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FOR BETTER CONSTRUCTION—SAFER MAINTENANCE

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Specify Kearney Products

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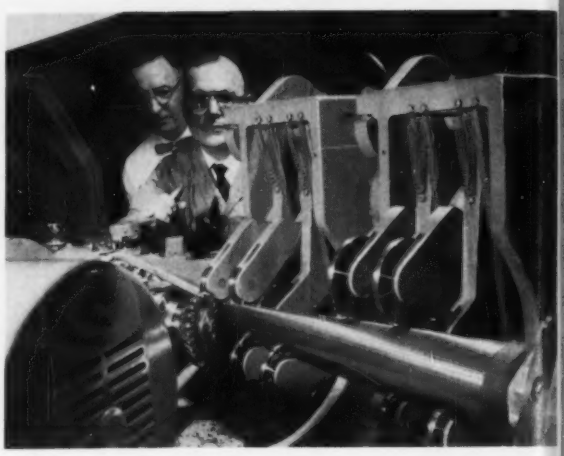
GE Unveils Automated Machine Tool Facility

Punched cards and magnetic tape are the brains that run a multi-million dollar array of automated machine tools just unveiled by General Electric's large steam turbine-generator department. The tools, which can do everything from drilling holes to contouring steam turbine buckets, are part of GE's answer to future demands for steam turbine-generators ranging from 50,000 to more than 500,000 kilowatts.

In photo right, a large bucket for a steam turbine is being shaped by a three-dimensional miller cutter that goes completely around bucket, cutting it to dimensions for final grinding and polishing. Path of cutter (at left in photo) is controlled by magnetic tape which is prepared by taking data from blueprints and transferring it to punched cards. These, with a program deck, are run through an IBM 704 computer and a half-inch magnetic tape is obtained. The tape is fed into an electronic director which interpolates and transforms the digital data on velocity, time and directions onto a one-inch magnetic tape. This final tape, with its continuous tool path information, operates through the machine's control system to direct the cutter.

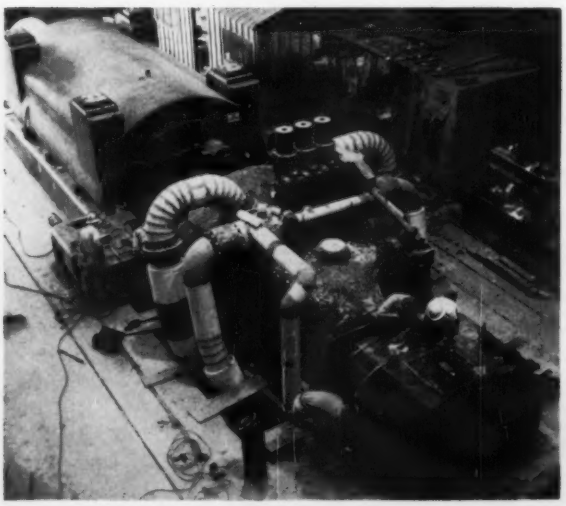
Other automatic machines in the array include one that does rough and finish boring of steam turbine cast steel inner shells—a complex problem because boring diameters vary from 16 inches to five feet. Another machine will drill, ream, and bellmouth 100 holes in one-and-a-half inch thick bronze in ten minutes.

GE says use of electronic controls allows greater flexibility and economy in automating small-lot production. A simple change of a tape reel or deck of business cards enables the machines to switch from producing one component design to another, eliminating lengthy set-up time and special fixtures.



In addition, lead time between completion of engineering drawings and production has been "trimmed to the bone". As an example, GE cites an automatically-controlled milling machine that turns out extruded copper bars just 45 minutes after a simplified engineering drawing has been completed and programmed on punched cards. This job formerly required 16 weeks of lead time and 60 manhours of production time.

The unveiling of the automated tools was part of GE's tenth anniversary celebration of its turbine-generator plant in Schenectady. Addition of these new machine tools gives the department the capacity to build enough units to meet the predicted future needs of the electric utility industry during the next several years.



Takes 14 Miles of Insulation

Insulation is installed on the second unit of the Clinch River Plant of the Appalachian Power Company at Carbo, Virginia. In operation since the first of this year, the 450,000 kilowatt plant promises to be a world leader in generating efficiency, with a current efficiency rate of 9100 BTU/kwh. Both units operate with input steam conditions of 2000 psi and 1050 degrees F, with reheat also to 1050 degrees.

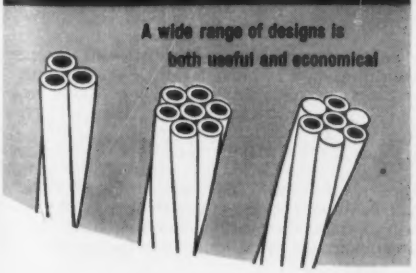
Plant required 14 miles of Kaylo pipe insulation as well as 731,000 board feet of the block type. Kaylo is a hydrous calcium silicate product, effective to temperatures up to 1800 degrees F, and is manufactured by Owens-Corning Fiberglas Corporation.

(*More News of Manufacturers, p* 122)

Now...a NEW overhead ground wire

ALUMOWELD™

Aluminum-Covered Steel Wire



Exclusive features—

a **thick cladding** of aluminum
a controlled **atomic weld**

Give your transmission lines permanent protection with the new light-weight, low-cost Alumoweld Overhead Ground Wire—the only aluminum-covered steel wire with a thick cladding of aluminum and the only one made by the controlled atomic-weld process.

Not only does Alumoweld have the strength of steel wire, but because of its 25% by area aluminum covering, it offers the added advantages of much higher conductivity and far greater service life. In fact, Alumoweld has corrosion resistance equal to solid aluminum wire, has one third the conductance, and eight times the strength.

In Alumoweld Overhead Ground Wire, you get three important benefits. (1) Its thick aluminum covering permanently protects the high-strength steel core against corrosion. (2) The electrical conductance is excellent for relaying and for discharging lightning and transient currents to ground. And, (3) Alumoweld's high strength permits stringing for ample mid-span clearance.

For more information on Alumoweld, write today for Engineering Bulletin E.D. 3000.

ALUMOWELD

COPPERWELD STEEL COMPANY
WIRE AND CABLE DIVISION Glassport, Pa.
For Export: COPPERWELD STEEL INTERNATIONAL COMPANY, New York

COMPACT

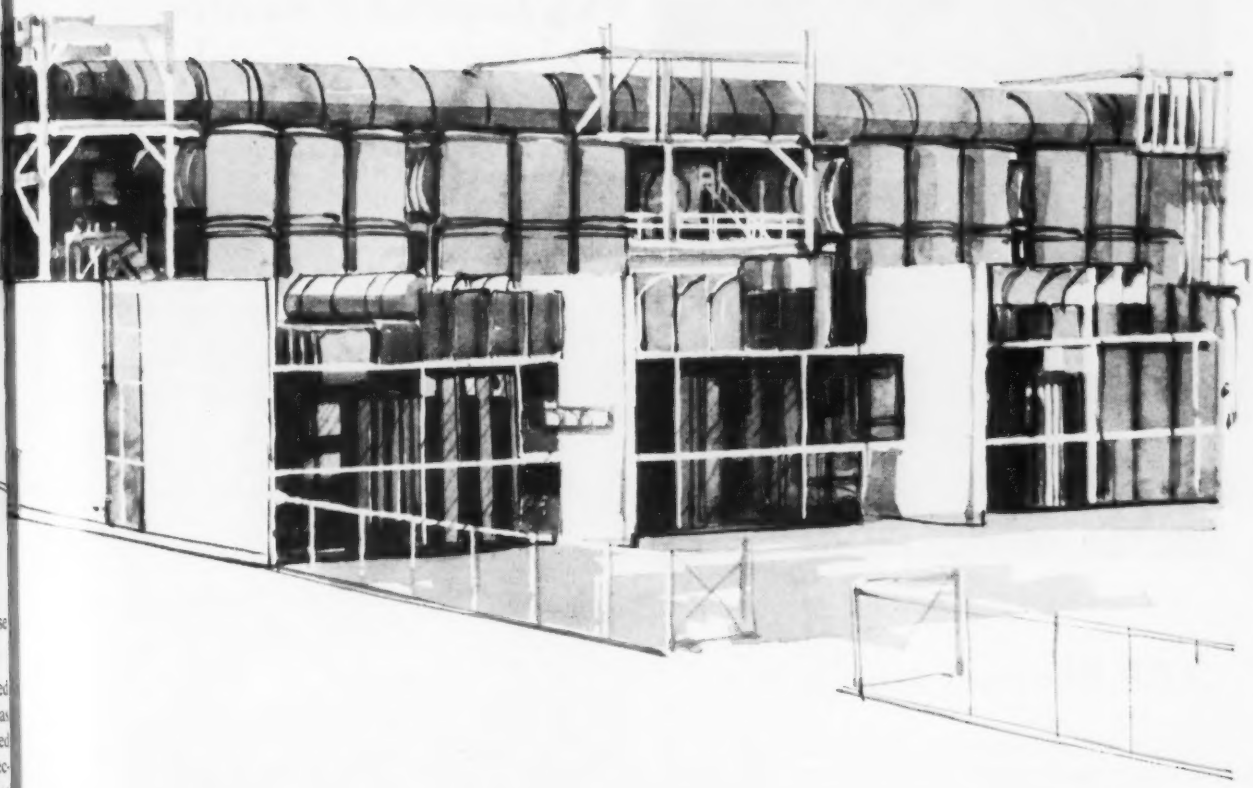
What! Call this giant 138 kv switching station compact? Yes indeed. In fact, it takes up an area roughly 30% smaller than would be required by conventional open construction. That's because it uses I-T-E isolated phase construction.

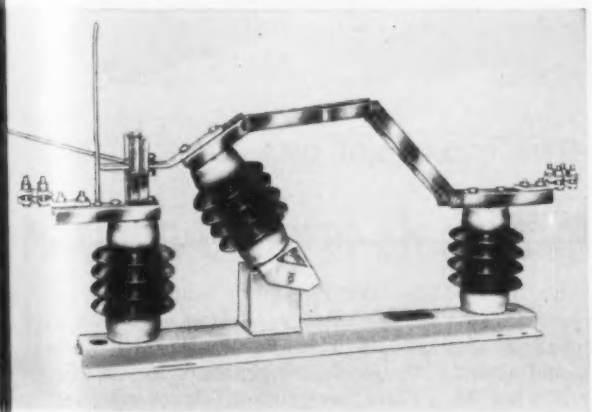
I-T-E high-voltage metal-enclosed switching stations can be installed in relatively small spaces with complete safety to personnel and nearby equipment. Maintenance is considerably easier. And in addition you are assured of better service continuity through virtual elimination of phase-to-phase fault risk. All conductors are completely enclosed.

The 138 kv installation illustrated was made at Consolidated Edison, New York. It was the first at this high voltage. It was logical that I-T-E should supply it. I-T-E introduced isolated phase bus . . . in 1937. Today some 25% of the nation's electric power flows through I-T-E bus. And other big advances in electrical equipment keep coming your way from I-T-E.

Duplicates an entire distribution network. Here at I-T-E headquarters, the I-T-E Network Analyzer gives fast, accurate answers to complex distribution problems. You can rent its services for problems of any complexity. Removable patchboard saves time. While one problem is being solved, the next problem can be set up. Five-degree phase shift design permits direct load setting on panel face. Automatic regulation maintains loads even though voltage changes. High impedance, 4000-ohm, 25-milliamp base prevents component damage from high currents. Resistors and reactors are separate, can be set independently.

New, more compact secondary unit substations. Save space at your generating station. Now I-T-E secondary unit substations need less space than ever. K-LINE circuit breakers stack four high in ratings up to 600 amp. They save roughly one-third in space. In addition, you get these other K-LINE advantages: quick manual make, closed door drawout even to disconnect position, expanded range trip unit that multiplies the application range. Only I-T-E builds these substations in a single plant . . . coordinating engineering and manufacture of interrupting switch, transformer and switchgear, and giving you better assurance of on-time delivery.





Shuntless tilting insulator switches. Note the absence of corrosion-prone flexible braid on I-T-E Tilting Insulator Switches. Instead they use a durable current-carrying linkage with silver-to-copper contacts at each hinge point. Silver to copper is also employed between the blade and jaw contacts. New crossarm adjustment permits compensation for warpage without demounting switch. Current rating can be increased with parts supplied in an easy-to-use conversion kit. Available with I-T-E LODRUPTER attachments for switching currents up to 600 amp. Switch voltage ratings from 7.5 through 34.5 kv.

I-T-E Circuit Breaker Company U-5
1900 Hamilton St., Philadelphia 30, Pa.

- ☐ Metal-enclosed high-voltage switching stations
- ☐ Network analyzer
- ☐ Secondary unit substations
- ☐ Tilting insulator switches
- ☐ Other .....
- ☐ Outdoor air switches
- ☐ Load interrupter switches
- ☐ Reclosers
- ☐ Distribution cutouts

Name_____ Title_____
Company_____
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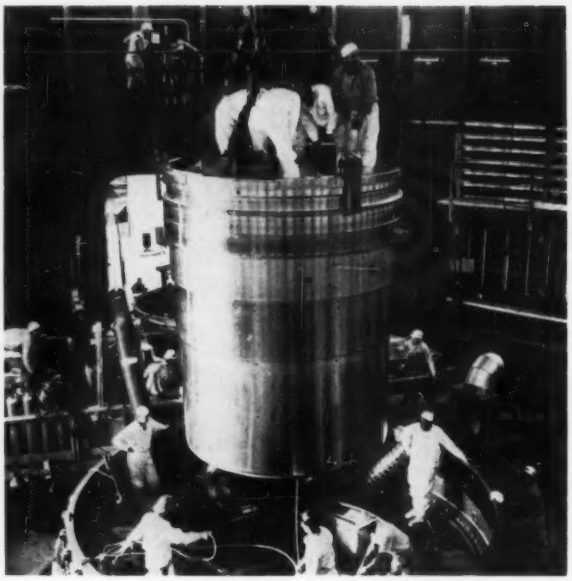
City_____ Zone____ State_____

SEND COUPON OR WRITE

Get complete, up-to-date information on I-T-E equipment.

I-T-E CIRCUIT BREAKER COMPANY



Plug Lowered in Reactor

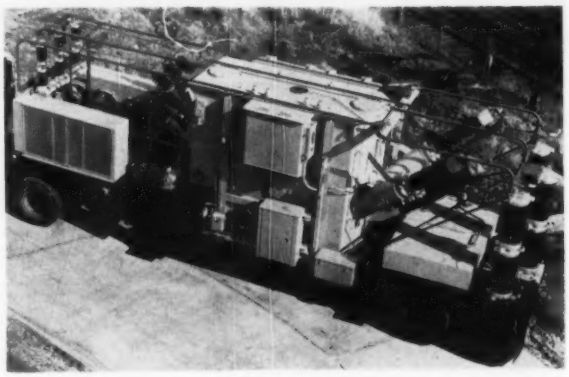
Rotating-shield plug weighing 106 tons and precision-machined to mirrorlike finish, is lowered into place for Enrico Fermi's 36-ft-high, 91-ton reactor vessel. Both the vessel and plug were built by the Chattanooga Div of Combustion Engineering, Inc, from basic designs supplied by Atomic Power Development Associates, Inc.

The plug can be rotated by means of a gear and drive mechanism to help position a fuel-handling device over any of the 639 fuel and blanket elements of the reactor. Of stainless steel, it has a carbon steel interior and canned borated graphite shielding to prevent escape of radiation.

Power Reactor Development Co is financing, building and will operate the nuclear portion; Detroit Edison is building the turbine-generator section which it will own and operate on steam purchased from PRDC.

CL&P Receives Mobile Sub

New England's largest mobile substation has been received by the Connecticut Light & Power Co. Weighing 109,000 lb when filled with oil and 34 ft in length, the trailer has a 22,500-kva transformer with three step-down voltages—27.6, 23, and 13.8 kv. General Electric built the unit, third largest in the nation.



MANUFACTURERS BRIEFS

The first unit of Commonwealth Edison's order placed with **Aluminum Co of America** for 44 aluminum transmission towers for its 138-kv line has passed full-scale load tests. The project is being conducted on an experimental basis, the second all-aluminum tower order fabricated by Alcoa. Shipment of the first portion is scheduled for late July or early August. Towers, of rectangular cross-sectional design, will be field-erected from extruded aluminum shapes, shipped ready for assembly with aluminum bolts . . . Commonwealth Edison has also contracted for installation of a **Westinghouse** 305-Mw turbine generator for its Waukegan generating station. The 1,926-ton unit is scheduled for delivery in July '61 and for operation in June '62 . . . **General Cable** acquires Indiana Steel & Wire, manufacturer of Crapo galvanized wire and strand, located in Muncie, Ind. Fred M. Crapo will continue as president and chief executive officer, also serving as vice president of General Cable . . . **Aluminum Co of America** transfers its aluminum conduit sales to Rome Cable, a recent Alcoa subsidiary. The move means Rome will have a full line of aluminum and copper conductors and accessories, aluminum and steel conduit. Glenn Rolston, Rome's vp and manager of marketing, announces that Dixon Lewis, Alcoa's former assistant manager of electrical conductor sales is product manager of Rome's new line. Lewis will operate out of Alcoa's Pittsburgh headquarters as a member of Rolston's staff . . . **Westinghouse** has built a 100-watt thermoelectric generator for the Air Force, weighing 40 lb, running on gas flame. The unit is not commercially available, but the design offers possibilities for future applications . . . A machine which coats 12 through 25-gauge wire with polyethylene at up to 2,000 ft per min is newly acquired by **Tennessee Eastman Co's** Application Section of the Tenite Development Dept, as part of the extension of research and development equipment and techniques . . . . **General Electric's** Meter Dept has produced its ten-millionth magnetic meter, with the magnetic-suspension principle for "floating" meter discs.

This "gold meter," General Electric's 10,000,000th magnetic-suspension meter, has just come off the assembly line at Somersworth, New Hampshire. It is a reminder that not one of the first 9,999,999 has ever been replaced because of bearing wear.

OVER 10 YEARS AND 10,000,000 METERS . . .

Not one General Electric magnetic-suspension meter has ever been replaced because of bearing wear

This month, eleven years since the introduction of the revolutionary I-50, General Electric's Meter Department produced the 10,000,000th meter with magnetic suspension. Of the first 9,999,999, not one "free-floating" system has ever been replaced because of wear. This service record stands as indisputable proof that General Electric meters, with magnetic suspension, assure a lifetime bearing system. Here's how it started:

Meter men for many years had requested a meter with a lifetime bearing system. In 1948, General Electric introduced the I-50—first of the magnetic-suspension meter family—as the answer to that request. Because of the widespread acceptance of the I-50 and the need to handle increasing loads, General Electric introduced the Class 100 I-55 in 1954 and the Class 200 I-60 in 1957. With the extension of magnetic suspension to the complete polyphase Class 10, 100 and 200 V-60 two-stator line, General Electric's full line of watthour meters has achieved an unexcelled record for accurate performance.

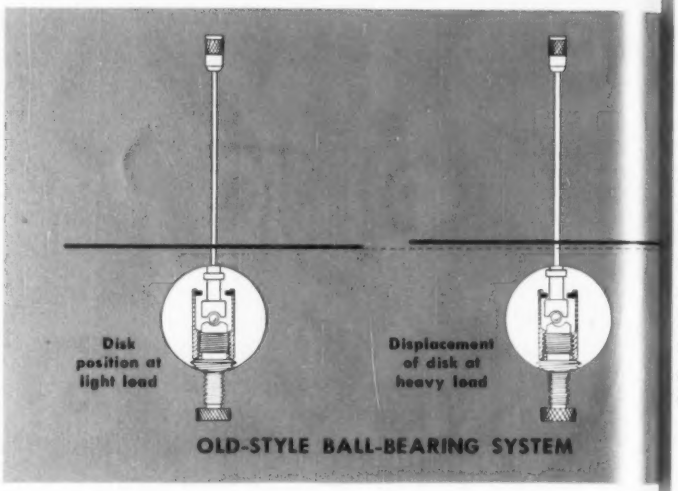
Progress Is Our Most Important Product

GENERAL ELECTRIC

HERE'S 5-WAY PROOF OF G MAGNETIC-SUSPENSION M

1 NO DISK DISPLACEMENT

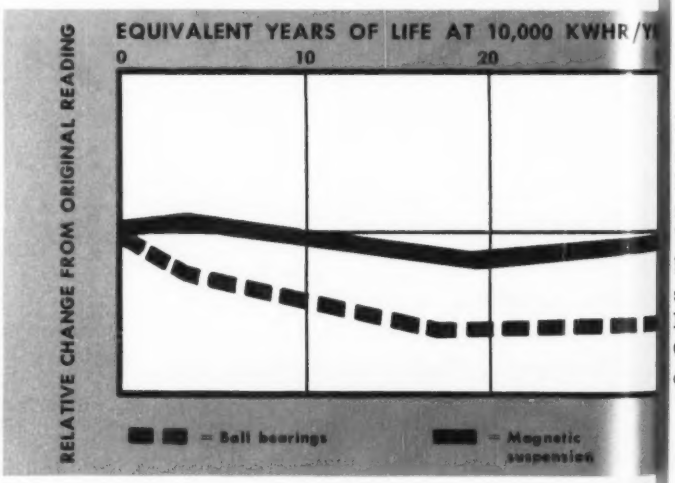
With conventional ball-and-jewel bearing systems, higher loads can force the disk out of position and cause inaccurate meter readings. Because of the basic design of General Electric's magnetic-suspension system, however, disk displacement at any load is not a significant factor, and meter readings are accurate through full meter range. You also eliminate bearing inspection, cleaning and replacement costs.



OLD-STYLE BALL-BEARING SYSTEM

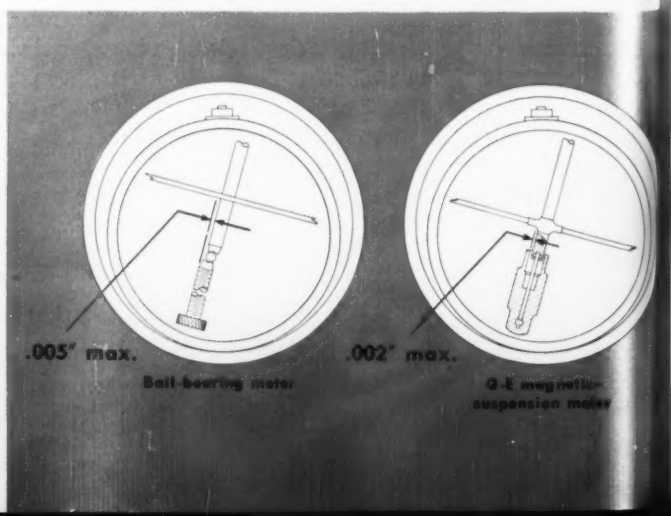
2 GREATER SUSTAINED ACCURACY

The proof is in the testing. Accelerated life tests prove that, over an equivalent of 30 years' operation at 10,000 kilowatt-hours per year, meters with magnetic suspension hold a higher sustained accuracy and incur considerably less bearing wear than meters with old-style, ball-bearing systems.



3 REDUCED TILT ERROR

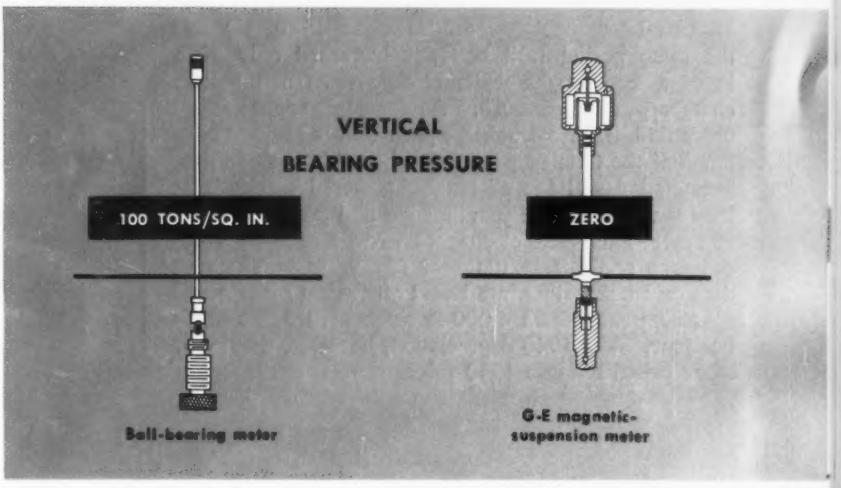
Because the disk and shaft in G-E meters are supported magnetically rather than by a ball and jewel, tilt error is minimized. As the angle of tilt is increased on ordinary ball-bearing meters, disk position changes—relative to the element and damping magnet—result in increased tilt errors. Close tolerance of parts in G-E meters minimizes disk position changes and tilt error, thus reducing revenue losses.



GENERAL ELECTRIC'S METER SUPERIORITY

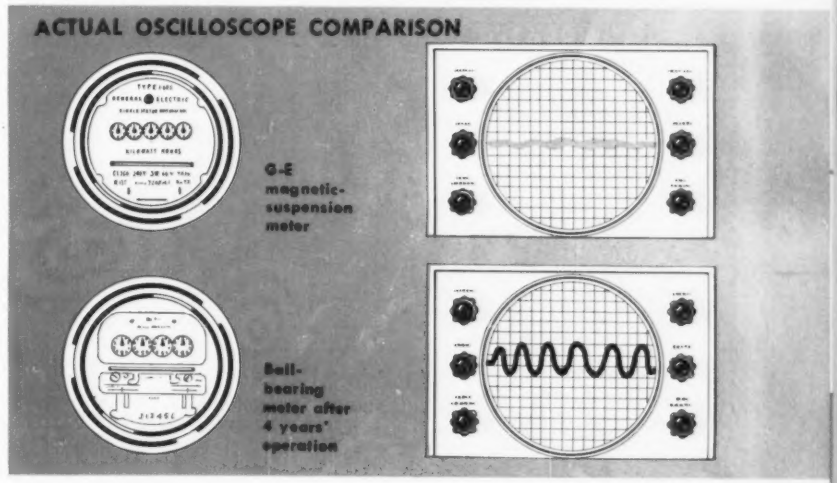
NO BEARING WEAR

In old-style, ball-and-jewel systems, the weight of the disk and shaft assembly exerts approximately 100 tons-per-square-inch pressure on the bearing. Bearing wear and attendant maintenance costs are inevitable. With G-E's magnetic-suspension system, vertical bearing pressure is zero because the entire weight of the rotor is supported by a magnetic field. Only G-E meters offer a true lifetime bearing system.



QUIETER OPERATION

Electric Utilities across the country have recorded instances where home owners have registered complaints about "noisy meters" outside nurseries or bedrooms. Where noise constitutes a problem, it has become common practice to replace old-style, ball-bearing meters with General Electric magnetic-suspension meters. G-E meters operate more quietly because the disk floats free.



TEN MILLION METERS WITHOUT A SINGLE BEARING FAILURE PROVE THE SUPERIORITY OF GENERAL ELECTRIC'S MAGNETIC-SUSPENSION SYSTEM

For complete information on this exclusive meter line, contact your G-E apparatus salesman or write section 628–29, General Electric Company, Schenectady 5, New York.

Progress Is Our Most Important Product

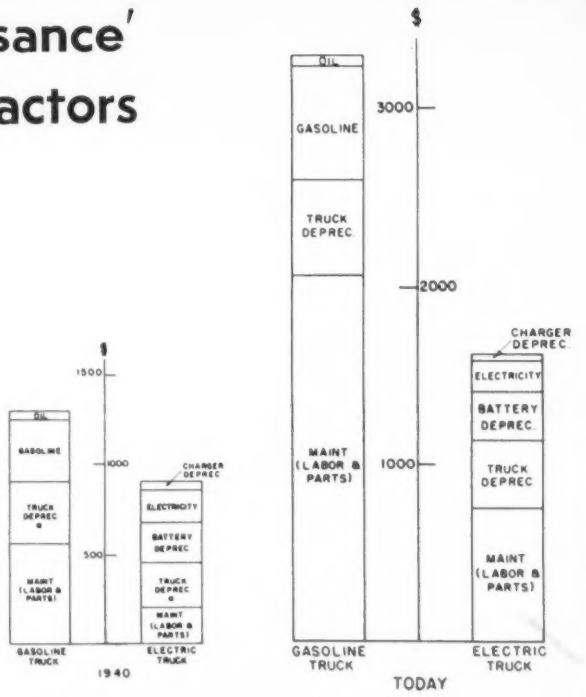
GENERAL ELECTRIC

Electric Vehicle 'Renaissance' Sparked by Low Cost Factors

Cost advantages are generating interest in a "renaissance" of electric vehicles. Evans Taylor, Chicago branch manager of Exide Industrial Division, Electric Storage Battery Co, stressed this point at a Lead Industries Assn convention last month.

"The cost of gasoline," Taylor said, "has risen an average of approximately 80% since 1940. During the same period lead batteries increased only 20% in cost per amp hr while electric rates and battery charger prices decreased. As for maintenance, most users find electric trucks require only one-quarter to one-half the time of gas trucks, he said. In addition, estimated useful life of battery powered trucks is at least ten years vs five years for gas and propane trucks.

Taylor predicted electric cars "will gain wide acceptance and use in the next few years." The cost data on trucks, right, are based on typical owning and operating costs for a 4,000-lb truck used 2,080 hours per year. The 1940 depreciation, however, uses 1947 truck prices because 1940 prices were unavailable.



$1,800 'Electric' Makes Dramatic Debut

PROTOTYPE of 'Nu-Klea Starlite' weighs 2,100 lb and has range of 75-85 mi at 35-mph. It has one-piece plastic body

CARRYALL of GM's Oldsmobile division shows advantages of battery-powered plant tours. Following is 1915 Milburn

A new contender for the electric car market made its debut last month in Lansing, Mich. It is called the Nu-Klea Starlite, and is a product of Nu-Way Industries, Inc, of Lansing.

It was a spectacular debut. As part of the city's centennial celebration, Lansing Board of Water & Light sponsored a parade section of electric vehicles.

The Starlite drew much interest from spectators as it rolled along the parade route—despite the competition of bands, drill teams, Miss America, and Captain Kangaroo. Nearly 100 persons swarmed about the vehicle when the parade ended, and Nu-Way Pres. Steven Kish, reports that he has since been "deluged with orders."

The model on display, a two-door sportster, is slated to retail for $1,500-$1,800, says Kish. It features a one-piece, all-plastic body; and is now powered by 12 six-v lead-acid batteries weighing about 150 lb each, although lighter batteries may be incorporated later. Range without recharging is now 75-85 mi.

In addition to the sportster, Kish contemplates building a two-door sedan, and eventually a station wagon and a light truck. He hopes to start filling orders for the sportster within 4-6 months, and plans call for potential output of at least 500 a year by May 1960.

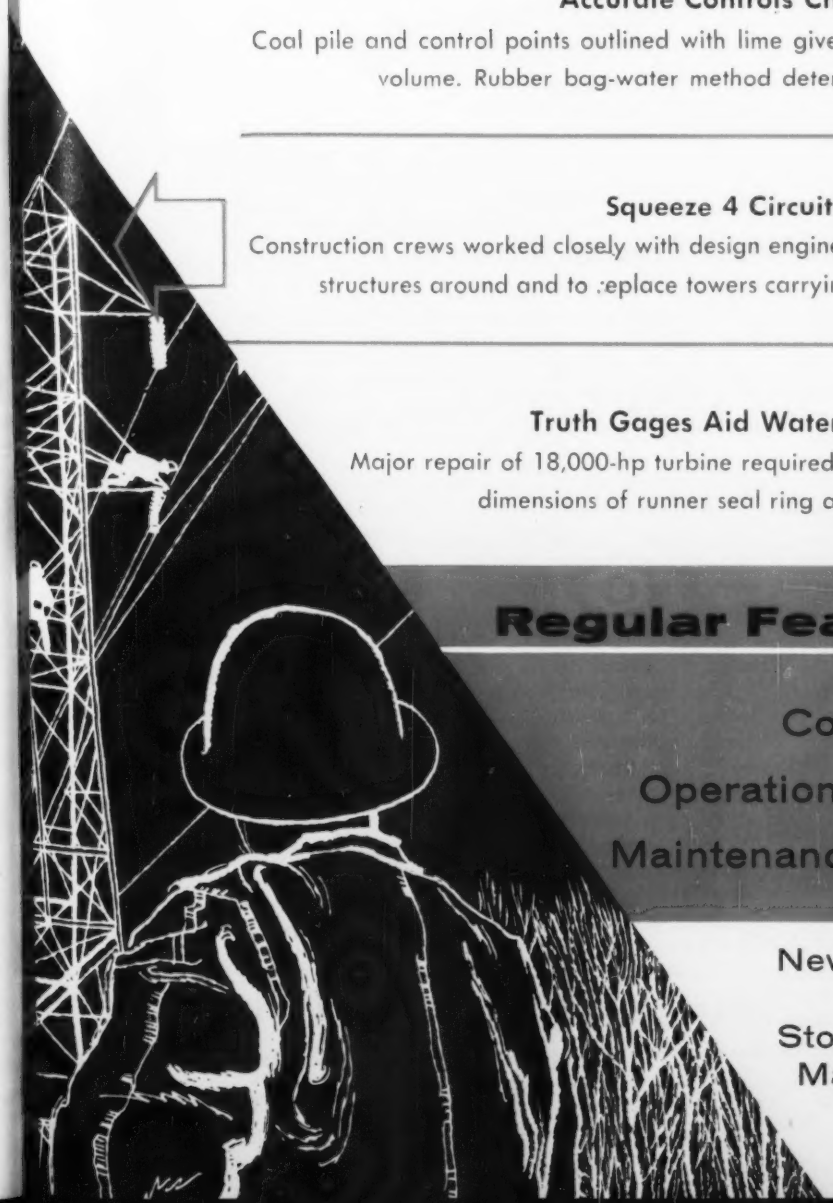
The prototype weighs 2,100 lb, including batteries, is 148 in. long, 62 in. wide, 55 in. high. It was completed in only four weeks with the aid of C. J. Monroe, General Electric sales engineer, Detroit apparatus sales division. He engineered the electrical system and rounded up two GE 2½-hp dc motors and other components just in time for the centennial.

Electrical World Special Report

JUNE 1959

ELECTRIC utility methods

CONSTRUCTION • OPERATION • MAINTENANCE



Accurate Controls Check Coal Supply
Coal pile and control points outlined with lime give accurate check on volume. Rubber bag-water method determines coal density. p 152

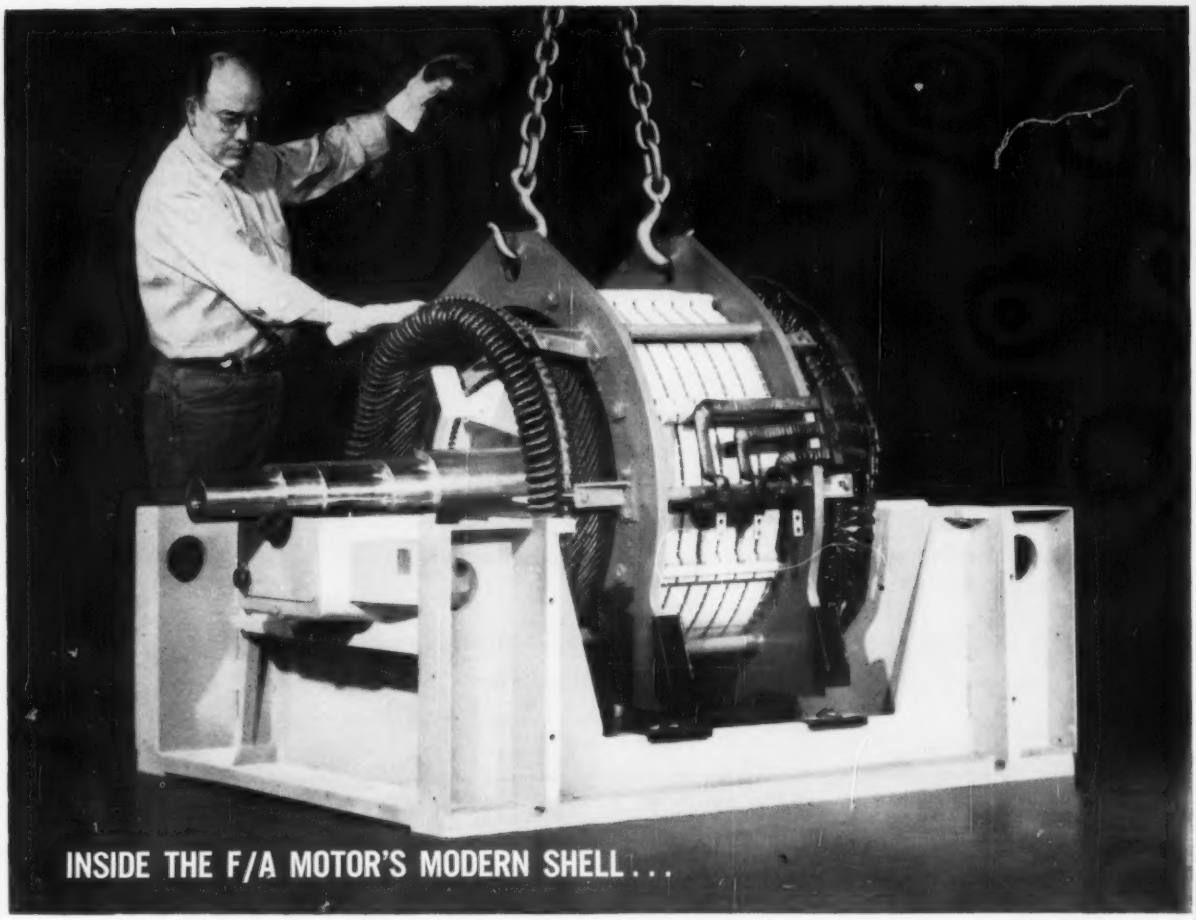
Squeeze 4 Circuits into 80-ft R/W
Construction crews worked closely with design engineers to build 115-kv structures around and to replace towers carrying 28 kv and 69 kv. p 149

Truth Gages Aid Waterwheel Overhaul
Major repair of 18,000-hp turbine required accurate control of dimensions of runner seal ring and distributor rings. p 156

Regular Features

Construction p 161
Operation & Testing p 170
Maintenance & Repair p 179

New Equipment p 129
Safety p 189
Stores & Shops p 194
Manufacturers Literature p 185



INSIDE THE F/A MOTOR'S MODERN SHELL...

long life, lowest maintenance, backed by 7000 success stories

WEATHER-TESTED FOR OVER TWO YEARS...WITH NO MAINTENANCE!

This conventional indoor, 600-hp motor with Thermalastic insulation has been running outdoors for more than two years. Built before the F/A Motor was introduced, it has been subjected to these rigorous conditions:

- Twenty-four hours a day, five days a week, with weekend shutdowns to produce stopping and starting surges
- Summer and winter, all weather and temperature extremes
- Two-week shutdown during which it was sprayed almost continuously with fire hoses

It is still running smoothly and shows no signs of insulation breakdown or other deterioration.

In 7000 large-motor installations and over 15 million horsepower of Westinghouse large rotating apparatus, not a single breakdown occurred from Thermalastic® insulation failure.

One reason for this amazing service record lies in the unique molecular structure of Thermalastic insulation. Large, overlapping mica splittings are locked in a void-free, memory-type elastic bond, forming a perfect dielectric barrier which is maintained under *all* operating conditions.

Because of Thermalastic, your F/A Motor serves you longer and better. This insulation system withstands prolonged voltages, abrasion, corona arcing and frequent-starting surges. F/A Motor applications are virtually unlimited because Thermalastic is chemically stable, will not react, dissolve, crystallize or evaporate in contact with acids, alkalis, oils, lamp black, dirt, moisture or temperature extremes.

Consider what these proved performance extras can mean in down time and maintenance savings alone. For more specific test data, call your Westinghouse representative, or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa. J-15013

YOU CAN BE SURE...IF IT'S Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV MONDAYS

NEW EQUIPMENT

To obtain more information on these items, use code numbers **indicated for each item when filling in** Readers Service Card

Mobile Cranes . . .

. . . can set their own outriggers and be ready to lift capacity loads within 30 sec. Known as the Series R-30 and Series R-45, they have capacities of 30 and 45 tons respectively. All operating functions of both are electrically powered. Variable speed regulated dc motors power hook line and boom swing. **R. G. LeTourneau, Inc, Longview, Tex.** **(1)**

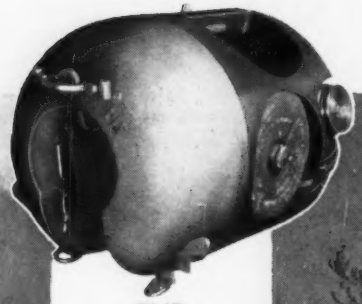
Transistorized Metal Locator . . .

. . . has one-turn transmitting/receiving coil cast into fiberglass case. Switches allow for use over good or poor conductive ground, and variable sensitivity and gain. Life of 1,400 hr is obtained on eight flashlight batteries powering 10 transistors. Carrying handle is adjustable. **Gardiner Electronics Co, 2545 E Indian School Rd, Phoenix, Arizona.** **(2)**

Heavy-Duty Electric Truckster . . .

. . . handles 1,000-lb payload plus two riders. Lead-acid or Edison batteries give up to 50 miles per charge. Flat bed, measuring 45⅝x61½ in., can be fitted with stake racks. **Cushman Motors, Lincoln, Neb.** **(3)**

(More New Equipment on page 130)



Neale Model "K"

END
TREE-TRIMMING
PROBLEMS

•

ELIMINATE
STORM
OUTAGES

with

AERIAL
CABLE

FIELD SPUN

•

It's Neater
Easy to Install
Proven in the Field

•

The new Model K pull-type Spinner was designed especially for power cables, with a background of many years' experience in telephone cables. It has been adopted as standard by many electric utilities.

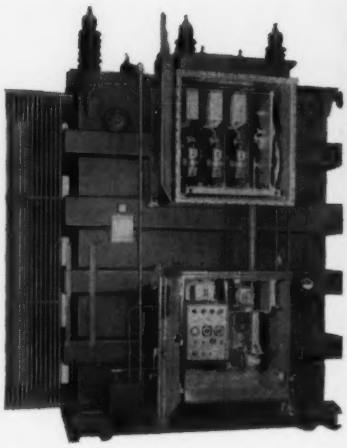
- Lashes three cables as large as 2" O.D. at one time.
- Lashes single cable as large as 3½" O.D.
- Lashes with one or two lashing wires.
- Lashes with wire of any type or size.
- Works on any size strand.
- Weighs only 36 pounds (less wire).

For descriptive information and application data please drop us a note.

CABLE SPINNING EQUIPMENT CO.

3100 Topeka Ave. Topeka, Kans.

Phone CE 2-7234



LTC Transformers . . .

. . . feature magnetic amplifier control and single main drive shaft. The 3-phase LTC transformers, with ± 10% voltage regulation in ⅝% steps, use magnetic amplifiers in the voltage sensing circuit to initiate a tap change. Their use results in accuracy of control, because the amplifiers can be set to function at precise limits, and in reliability of operation, because they have no moving parts. A single main drive shaft, coupled to the drive motor and to the drive pinion of the transmission assembly, provides direct, positive actuation of the tap changing switches.

Wagner Electric Corp, 6400 Plymouth Ave, St. Louis 14, Mo. (4)

Lighting Control . . .

. . . for pole-top installations is designed for use with large mounting bases. Model 6607A

(*Continued on page* 133)

Sold only through Insulator Manufacturers

Proven rugged by long service in utility systems throughout the world! Cast from high strength, non-corrosive aluminum alloy. Light weight reduces conductor damage . . . flared mouth design prevents chafing. Engineered for minimum hysteresis and eddy current losses. Clevis pin locked against rotation. Speed cotter key facilitates maintenance while energized.

ANDERSON ELECTRIC CORPORATION • BIRMINGHAM 1, ALABAMA
Export Representative: International Standard Electric Corporation
50 Church Street, New York 7, N.Y.

ANDERSON ELECTRIC

Research / Quality / Performance / in Aluminum and Bronze Products

Aluminum and Bronze Power Connectors • Clamps • Fittings • Accessories for SUBSTATION • TRANSMISSION • DISTRIBUTION

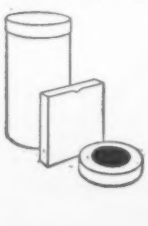
CIRCLE 95 ON READER SERVICE CARD

Tape it easy, Mac!

Gold Seal Tape sticks tight in any weather

You can do a first-class insulating job — easier and faster — with Gold Seal Friction Tape. It tears evenly, conforms readily to uneven surfaces, sticks *tight* in any temperature and under all weather conditions. And one thickness *insulates.* For lasting "tack", for all-around insulation protection, ask for Gold Seal Friction Tape. Made by Jenkins Bros., Rubber Division, 100 Park Avenue, New York 17.

In 10-roll containers or single rolls • Each roll sealed in cellophane, stays fresh



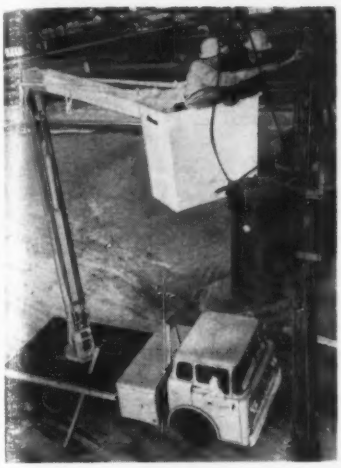
Gold Seal **FRICTION** • *Rubber • Plastic Tapes...Commercial and Specifications Grades*

Lighting Control

(*Continued from page* 130)

will fit mounting bases up to 3⅝ in. diameter, such as ornamental pole tops and certain luminaires. Model 6607A and other units in the tubeless 6600A Series all conform to EEI-NEMA standard for twistlock controls.

Fisher-Pierce Co, S Braintree 85, Mass. (5)



Aerial Platform . . .

. . . is available with fiberglass boom tested with potentials of 230 kv ac between operator's platform and grounded boom base. Except for bronze bushings where the operator's platform attaches to the boom, all parts of the boom from the base outward are of insulating materials. Two models are available, 40HFD for working heights up to 40 ft; 50HDF for working heights up to 50 ft.

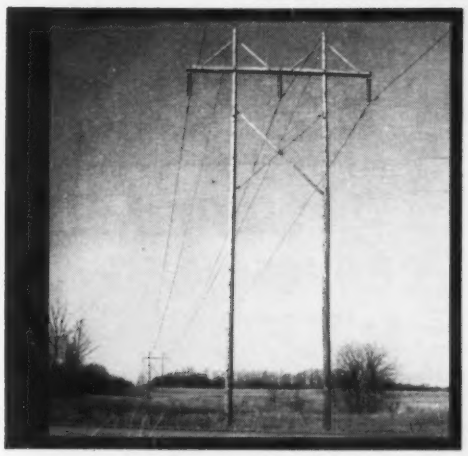
Pitman Mfg Co, Grandview, Mo. (6)

Oil Circuit Breakers . . .

. . . have ratings increased from 250 Mva to 500 Mva at 14.4 kv while reducing interrupting time to three cycles. Interrupters have been redesigned using the prin-

(*Continued on page* 134)

GALVANIZED STEEL STRAND

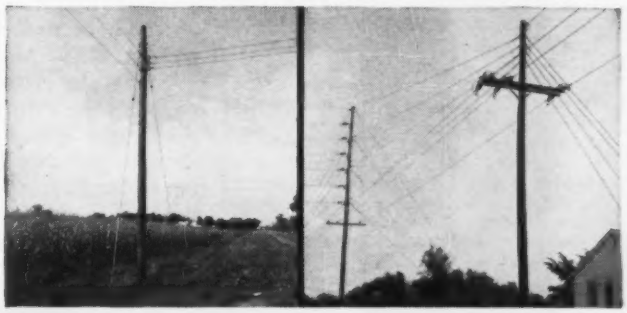


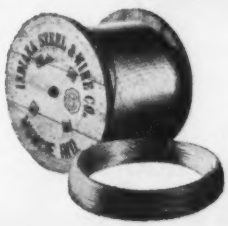
YOUR ASSURANCE OF HIGH QUALITY, LONG LIFE AND LOW COST

Close laboratory control over each step in manufacture has established Crapo Galvanized Steel Strand as a product of highest quality and dependability. You benefit through longer service life and lower ultimate costs.

Heavy, uniform, tightly-bonded coatings of commercially pure zinc, applied by the famous Crapo methods, withstand the punishment of construction, provide maximum resistance to corrosion and contribute to over-all economies.

For OVERHEAD GROUND WIRE . . .
CRAPO Weldless Galvanized Steel Strand





The most practical and economical strand for shielding transmission lines against lightning. Maximum strength and high fatigue endurance, inherent in Crapo Weldless Strand, provide that extra safety factor so important in overhead ground or static wire.

For GUYS and MESSENGER . . .
Crapo Galvanized Steel Strand. Made to highest standard specifications . . . a size and breaking strength to meet all practical needs.

Contact your jobber or write for descriptive folder.

INDIANA STEEL & WIRE CO., INC.
Muncie, Indiana

ARMY and NAVY Also Use JAQUES Hydraulic EARTH AUGERS

*Pole-setting attachment optional.

ARMY REPORT ON JAQUES KJ-254**

"There was a performance test on Pilot Model (Jaques Earth Auger), Model KJ-254, built by Texoma Enterprises, Inc. This test performed in accordance with Military Specification Mil-A-516B, paragraph 3.9 through 3.9.2.

"This test was performed in sandy, gravelly, red clay, hard and dry to blue silty clay at bottom of hole. Average time per hole for 25 consecutive holes was 78 seconds. Average depth of holes was 67.2 inches. Machine functioned at normal temperature."

***JAQUES newly developed Model TJ-254 is 2½-TIMES FASTER than Model KJ-254!**

Some of 29 JAQUES TJ-254's NAVY bought.

WHY BUY JAQUES?

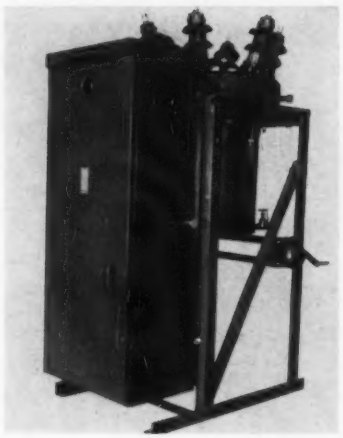
1. JAQUES Augers have finger-tip, feather-touch controls... only 3 primary adjustments for easy, simple operation ... Mount on standard trucks...
2. JAQUES drill holes up to 60" diameter ... up to 25' deep in toughest soil... even in rock... FASTER, CHEAPER...
3. JAQUES have fewer moving parts for longer life... lower maintenance and operation costs... less "down time"...
4. JAQUES dig holes up to 45° angle, either side of truck... Patented pressure control takes strain off all parts when rock drilling...
5. FIRST Jaques built 29 years ago is STILL IN OPERATION!

MAIL TODAY

EXOMA ENTERPRISES, Inc.
Manufacturers of JAQUES Earth Augers
HIGHWAY 75 NORTH, SHERMAN, TEXAS

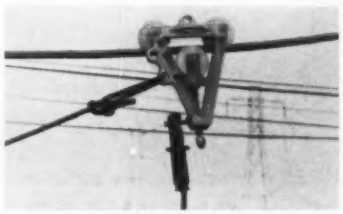
☐ Send me FREE detailed literature.
☐ Have representative call. No obligation.

NAME_____
TITLE_____
ADDRESS_____
CITY_____ STATE_____



ciples of the tubular-type De-Ion grids used on high-capacity oil circuit breakers. Grid stack is enclosed, except for exhaust vents, and the contact entrance hole is located at the bottom of the breaker.

Westinghouse Electric Corp, Box 2278, Pittsburgh 30, Pa. (7)



Traveling Ground . . .

. . . may be used on conductors as large as 795 Mcm ACSR. No. 795 traveling ground has bronze oil bushings, brush pickup with shunts to common ground, brass shoulder bolt axle and shouldered pin to attach ground clamp. The lightweight unit operates in either vertical or horizontal position. All parts are replaceable. A Heli-Coil thread is used in the frame.

W. M. Bashlin Co, Grove City, Pa. (8)

Aerial Ladders . . .

. . . in a new line feature upper ladder section handrails built into fiberglass and a tri-plane basket

(*Continued on page* 135)

Seal oil IN! Seal moisture OUT!

with

J-M TRANOLSEAL

developed especially for efficient sealing against refined oils

You can stop the dangerous and costly leakage of oil from transformers and switchgear with Johns-Manville's Tranolseal sealing compound. This permanently plastic material has a nondrying vegetable oil base. It provides effective sealing action against air (dust and moisture), inert gas, water, 13% NaCl brine as well as medium to high viscosity refined oils. Thus you can also prevent penetration by moisture and other ambient sources of trouble.

Tranolseal has excellent adhesive qualities and will not corrode or deteriorate metals, rubber or plastics. It shows good resistance to weather and aging (both painted and natural) and won't stain. Furnished in 1" diameter beads. For further information write Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit (Toronto), Ontario.

Johns-Manville SEALING COMPOUNDS

Aerial Ladders . . .

(*Continued from page* 134)

to give workers a flat surface regardless of ladder angle. Ladders are available in heights of from 24 to 45 ft. Three models include TML Series Manual Aerial Ladder, raised by a hand-operated hydraulic system; TEL Series Hydraulic-Electric Ladder, raised by a 12-v dc motor; and TFPL Series Fully-Powered Aerial Ladder.

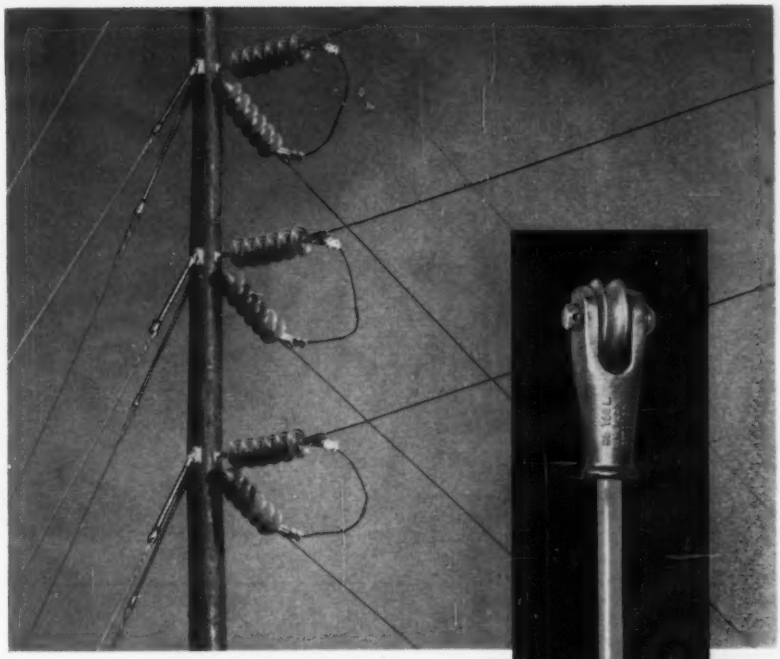
Truck Equipment Co, 3963 Walnut St, Denver 5, Colo. (9)

Power Supply . . .

. . . for field and laboratory testing of relays, circuit breakers, ammeters, current transformers and other equipment is now available. The portable units have means for varying the output current, include overload protection, have convenient termination and are provided with test leads.

Multi-Amp Corp, 465 Lehigh Ave, Union, N. J. (10)

(More New Equipment on page 136)



Proven in Service

EMPIRE FIBER GLASS GUY STRAIN INSULATORS

Featuring:

STRENGTH • INSULATION • PERMANENCE • APPEARANCE • ECONOMY

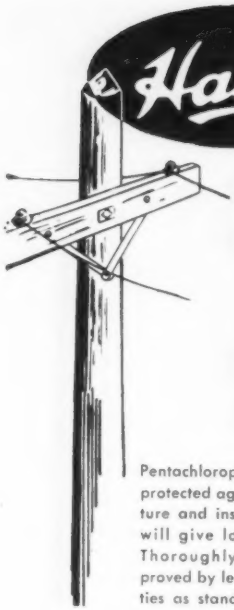
GLASS-STRAINS introduced by Empire Metal Products Company to the utility market years ago.

Fiber glass rod produced by Empire Metal Products Company with strength greater than any guy wire requirement.

Carefully designed end fittings to provide the ultimate in strength and holding power are attached to rod by exclusive patented process.

CATALOG AVAILABLE

EMPIRE METAL PRODUCTS CO.
5443 West Roosevelt Road
Chicago 50, Illinois



Haley's

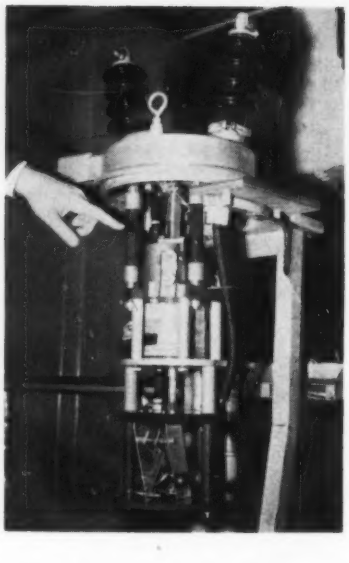
CEDAR POLES • FIR CROSS ARMS

Pentachlorophenal Treated—protected against decay, moisture and insect damage, and will give long service life. Thoroughly tested and approved by leading public utilities as standard construction.

• *Two strategically located yards*
MINNEAPOLIS, MINNESOTA
FINDLAY, OHIO

R. G. HALEY & CO.
Spitzer Building
Toledo 4, Ohio

CIRCLE 164 ON READER SERVICE CARD



Sequence Device . . .

. . . for Type HR Automatic Reclosers can be adjusted and changed in the field during routine maintenance. Incorporated in the company's complete line of reclosers, the sequence and timing device allows units to be moved to other parts of a system where operating sequence conditions may be unlike those set at the factory. Field adjustments of operating sequences are made by adjusting a cotterpin which changes the number of recloser operations.

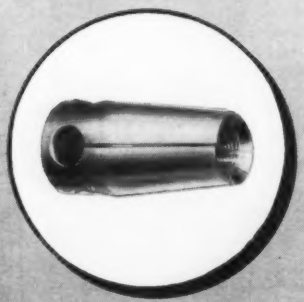
General Electric Co, Schenectady 5, N. Y. (11)

Ground Mats . . .

. . . of silver-soldered wire mesh prevent potential gradients at ground surface. Known as Trylon, mats come in 12x60-ft rolls with 2-ft mesh spacing. They are unrolled in position, tied to ground rods and buses, and covered with earth or slag. Brazed silver-solder joints meet 450C requirements and strength exceeding 250 lb (copper) and 300 lb (Copperweld).

Wind Turbine Co, West Chester, Pa. (12)

FARGO "AUTOMATICS" . . .

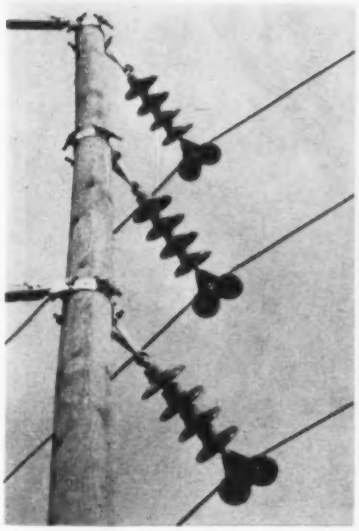


they work right because they're made right....

You get perfect, every time gripping action with the Fargo "one piece" jaw . . . the four segments precision machined from solid bar stock are always in alignment to move forward evenly gripping the conductor to its full rated strength

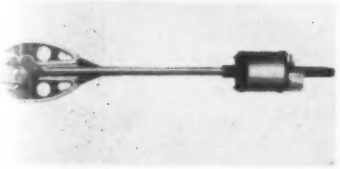
Ask your Line Material Field Engineer for details about the complete range of sizes and types for copper, aluminum or aluminum alloy conductors.

Stringing Blocks . . .



. . . incorporate horizontal twin sheaves instead of the customary single type. Known as Triangle Tandem Travelers, the blocks provide equalized support for superior stability and positive alignment. The wide threading channel lets conductor ride flat across the top, lessening angles of sag and reducing stress on conductor. A simple socket-eye hinge attachment gives positive hold to insulator and allows instant opening and closing of block. Blocks come in four sizes. **Keystone Services, Inc, Box 7766, Denver 15, Colo. (13)**

Guy-Strand Cutter . . .



. . . cuts cleanly through steel strand up to ½-in. diameter in one stroke. Air-powered unit has continuous cutting action once the trigger is tripped.
A. B. Chance Co, Centralia, Mo. (14)

(More New Equipment on page 138)

PHASE SHIFTERS

Type R

Made in 50 to 2500 volt ampere capacities. Provides means for shifting phase continuously for every possible angular displacement. May be obtained as combination of phase shifter and induction regulator, with single or double voltage on either primary or secondary and for 25, 50 or 60 cycles. The 50, 100 and 200 VA sizes may be furnished with carrying handles. Star or Delta connections supplied if desired.

Specify STATES—Pioneers in the Development of Electrical Testing Equipment

THE STATES COMPANY
19 New Park Avenue • Hartford, Conn.

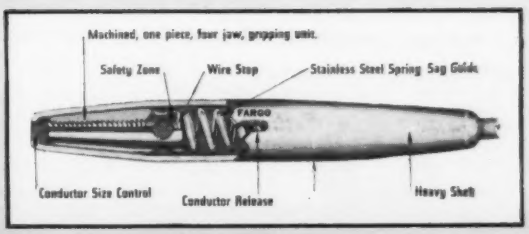
CIRCLE 165 ON READER SERVICE CARD

. . SAVE TIME, MONEY, TROUBLE

Permanent splices are quickly made by simply inserting the conductor and applying tension to the line. Costs are held to a minimum as splices are completed in a fraction of the time without the use of expensive tools.

The resulting splice is mechanically stronger with a resistance less than an equal length of conductor. Full insertion is easily checked by looking in the release slot.

Linemen's safety is greatly increased as the danger of accidental tool contact with energized lines is eliminated and fatigue from handling heavy tools disappears.



Distributed by
LINE MATERIAL INDUSTRIES
McGraw-Edison Company
Milwaukee, Wisconsin
In Canada, CANADIAN LINE MATERIALS, LTD., Toronto, Canada

Manufactured by
FARGO MFG. COMPANY, INC.
Poughkeepsie
New York

FARGO

CIRCLE 101 ON READER SERVICE CARD

PROTECTION AND BEAUTY, TOO

There's No Other Paint Like Subox

...Because Subox is the only paint in the United States made with chemically-active lead-suboxide. Unlike the pigments of inert paints, lead-suboxide changes chemically after drying to form an increasingly tough protective coating — rust inhibitive, acid and alkali resistant. Subox effectively safeguards metal surfaces: buildings, transformers, fences.

...Because Subox paint comes in modern, bright pastel shades, as well as darker colors, painting for normal maintenance can produce attractive decoration appropriate for neighborhood surroundings.

...Because Subox covers with a dense, impervious film, a single coat often is sufficient. Subox is both economical and good looking.

Write today for technical literature and color card.

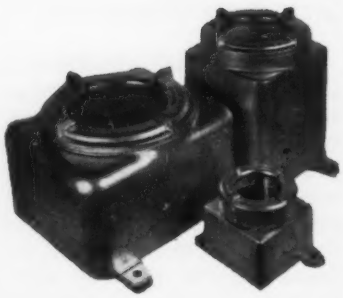
SUBOX PAINTS

Subox Inc.

Established 1924

3 Fairmount Plant, Hackensack, N. J.

Subox Company of Canada, Weston, Toronto 15



Enclosures . . .

. . . for instruments and meters are available in cast aluminum alloy explosion-proof models. They range through six sizes to accommodate instruments and meters from 3½-in. round to large GE types AB18 and DB18 and Westinghouse K24 meters. Stocked blank, the enclosures are drilled and tapped to specifications.

Adalet Mfg Co, Cleveland 11, Ohio. (15)

Special Terminals . . .

. . . to solve aluminum clamping problem are features of distribution transformer. The terminal, called "Uni-Grip", has a special washer which maintains pressure adequate to compensate for aluminum cold flow. Another feature is flowed tin plating on bronze body and eye-bolt to assure maximum compatibility with either aluminum or copper. The "Uni-Grip" terminal, available on all distribution transformers, was designed by Anderson Electric Corp, Birmingham, Ala., working with CTC engineers.

Central Transformer Corp, Pine Bluff, Ark. (16)

Articulated Boom . . .

. . . provides working height of 35 ft for the maintenance man. Designed especially for street light maintenance, the truck body features compartments for both new lamp stock and for convenient disposal of used and broken

(*Continued on page* 139)

Bashlin's Quality

FOR OVER 30 YEARS
Choice of Experienced Linemen

FULL FLOATING SHIFTING DEE BODY BELT . . .

Bashlin Quality again is outstanding in this "safety first" body belt. Comfortable, with tools in easy reach . . . Doubly Safe because Bashlin Body Belts have the additional Nylon Safety Feature.

The Bashlin Quality Line of Linemen's Safety Equipment is complete . . . Buy the best from a manufacturer with Long Proven Experience.

You Can't Afford Anything LESS Than the BEST—
Buy BASHLIN
Highest Quality For Over 30 Years
Distributors in Strategic Areas in U.S.A.
EXPORT: Copperweld Steel International Co. IN CANADA: A. B. Chance Co. of Canada Ltd., Toronto

Ask for . . .
CATALOG NO. 55

W. M. BASHLIN CO.
GROVE CITY, PA.

CIRCLE 108 ON READER SERVICE CARD

Articulated Boom . . .

(*Continued from page* 138)

lamps. Known as the Strato-Tower Series LST, the unit is designed for two-man operation. **Strato-Tower Div, Young Spring & Wire Corp, Box 103, Elkhart, Ind. (17)**

Protective Lotion . . .

. . . guards against rashes caused by exposure to chemicals, oils, grease, solvents, plastics and paint. Known as Vanfaire, the product is applied like any hand lotion. It is soluble in soap and water and protects the hands up to 12 hr.
Vanfaire Co, 10732 Riverside Dr, N Hollywood, Cal. (18)

Cable Pedestals . . .

. . . for secondary distribution simplify above-ground connec-

(*Continued on page* 140)

THIS IS A WATER WATCH

Now in use at leading power plants*, the

TECHNICON®
AutoAnalyzer®

conducts continuous automatic sampling and analysis of feed water for multiple steam-generating units in cycles of hundreds of times a day . . . *without attendance* . . . with a precision that permits measurement of trace materials down to parts per billion ± 1%.

The Technicon® AutoAnalyzer® is a round-the-clock watchman protecting the generating efficiency of power plants. Like a "Little Brother" it keeps a continually curious eye on the boiler feed water passing by . . . automatically analyzing it to insure that characteristics are near-ideal for maximum steam-generating potential with minimum corrosion and scale.

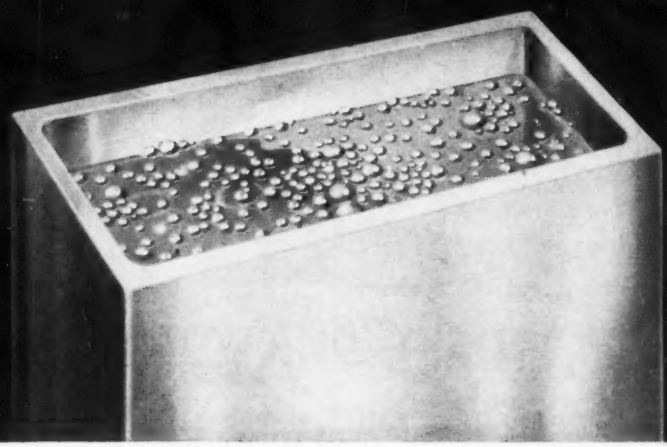
A brochure and application data tell the whole story of this automatic "water watch." Send *today*.

**Such as: Consolidated Edison of N.Y., Niagara Mohawk Power, Detroit Edison.*

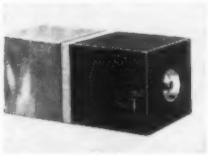
TECHNICON CONTROLS, INC.
CHAUNCEY, NEW YORK

CIRCLE 167 ON READER SERVICE CARD

ONLY ACOUSTICA ULTRASONIC CLEANERS HAVE MULTIPOWER!



MAJOR BREAKTHROUGH IN ULTRASONIC TECHNOLOGY!



In determining which ultrasonic cleaner to buy, remember that all ultrasonic cleaners are not alike. There is variation in uniformity of cavitation. There is variation in the transducer — and the transducer is the heart of an ultrasonic cleaner. The Multipower transducer developed by Acoustica research, multiplies the power and efficiency of ultrasonic action. Cleaning is faster, labor costs are lower.

Acoustica ultrasonic cleaners are engineered and produced to the finest standards, unequaled in quality and value. Off-the-shelf in capacities from 1 to 75 gal. or custom built to 5000 gal. Expert Acoustica engineers can help you with your cleaning problems.
Send for further information.

NEW YORK
LOS ANGELES

acoustica

LEADER IN ULTRASONIC RESEARCH AND DEVELOPMENT

©1959 By Acoustica Associates, Inc.

Acoustica Associates, Inc.
Dept. EW, Fairchild Court, Plainview, N. Y.

Send information describing advantages of Acoustica ultrasonic cleaners.

Name_____

Company_____

Address_____

City_____ Zone_____ State_____

Cable Pedestals . . .

(*Continued from page* 139)

tions of buried secondary service to underground mains. A large removable dome projects 18 in. above ground for ease of location and maintenance. Provision for padlocking make the pedestal tamperproof. Included is a parallel-groove neutral clamp that will accommodate two 2/0 stranded conductors. The pedestal can accommodate 4-in. fiber conduit risers for protecting conductors below ground level. **Line Material Industries, McGraw-Edison Co, Milwaukee 1, Wis. (19)**

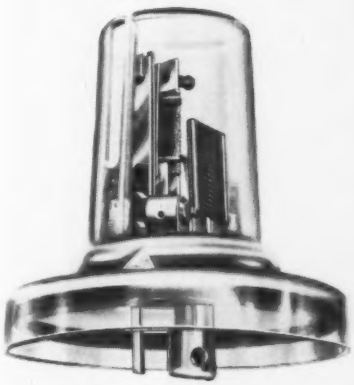
Warning Light . . .

. . . provides sharp, evenly spaced flashes at the rate of 50-60 per minute. Known as "Blitz", the kerosene-fueled light is never out, even between flashes. The light source is magnified 30 times during flashes through two 3¼x8-in. plastic prismatic amber or red lenses. It will operate for 50 hr on ½ pint of kerosene. **Wm. W. Lee & Son, 20 E Jackson Blvd, Chicago 4, Ill. (20)**

Electric Hoists . . .

. . . have lifting capacities from 2,000 to 50,000 lb. The new line offers a choice of lug, hook, plain, hand-geared or motor-

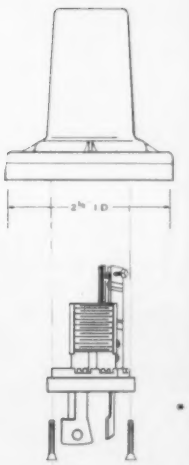
(*Continued on page* 143)



Precision

PHOTOELECTRIC OUTDOOR LIGHTING CONTROLS

2 components switch and cell



The field designed PMC control is rugged, dependable and inconspicuous. PMC engineers originated and pioneered the simplified tubeless photocontrol circuitry utilizing an integrating relay directly operated by a CdS photoconductive cell. The elimination of multi-component unreliability has been achieved by PMC.

FEATURES:

- Designed to EEI-NEMA Standards TDJ-148
- Large Area CdS Photoconductive Cell
- Component Protection — Lightning Arrester
- Small Size—Height 2 1/16", Base 2 3/4" I. D.
- Ambient Temperature Compensation — —40°F to +170°F
- Time Delay
- Tubeless
- Fail-Safe Operation

A complete line of Precision Photoelectric Lighting Controls is available in 120V or 240V models to meet your every need.

FOR COMPLETE TECHNICAL INFORMATION *write for* NEMA SPECIFICATION BULLETIN 459 AND FOR BULLETIN 460.

PMC

PRECISION MAGNETIC CONTROLS, INC.

233 CHESTNUT STREET, RIDGEWOOD, NEW JERSEY

here's
a powerful
combination!
HIGHWAY'S
HEAVY-DUTY
"HC" DIGGER...
mounted on a
"BLUE OX"
Rugged, powerful digging operation in any type of soil
The Highway HC earth-boring machine can be easily mounted on the "Blue Ox" vehicle or heavy-duty trucks. The compact unit connects to the transfer case with a single drive shaft. Easily available controls allow one-man operation. Highway's exclusive telescoping derrick enables 75' poles to be set. The "HC" machine digs holes from 9" to 38" in diameter, 10' deep. Overall height of both vehicle and derrick is under 10' in traveling position. Write to Highway for further information on this Heavy-Duty HC Earth-Boring Machine, and on the other models available.
HIGHWAY
UTILITY DIVISION
HIGHWAY TRAILER COMPANY
HEADQUARTERS: EDGERTON, WISCONSIN
Manufacturers of: Public Utility Bodies • Earth-Boring Machines • Pole and Cable Reel Trailers • Winches
Power Take-offs • Service Accessories • Commercial Trailers • Trailerized Tanks and Dry-Bulk Haulers
SALES AND SERVICE IN PRINCIPAL CITIES

ONE BIT FITS BOTH

1. Hand Brace

2. Electric Drill

New Irwin Adapter Shank Wood Bit

Now you can eliminate the need to stock two types of wood auger bits. Irwin's new Adapter Shank Bit fits both hand braces and power drills.

With hand braces, use the Adapter Shank Bit as it comes. Cut off taper square and the Adapter Shank, with its 6 "hex flats", chucks perfectly in power drills or hand braces, either one. No wobble, no run-out. Clean, efficient cutting action. Reduces inventory and record keeping by 50%. Saves time on the job, too. Call your distributor, or write today for complete information. Sizes 4/16" to 17/16", both solid center and single twist types.

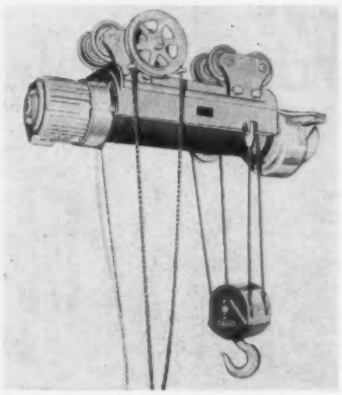
All Irwin Adapter Shank Wood Bits are forged in one piece from special steel and heat tempered full length for longer life. Plastic coating on balanced cutting heads guarantees factory-fresh sharpness, unequalled performance. Widely used by utilities, electricians and construction workers.

IRWIN auger bits • screw drivers
Wilmington, Ohio

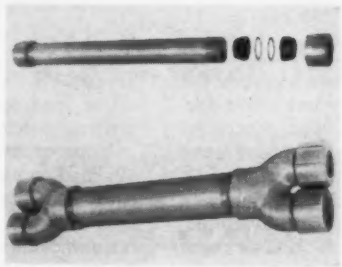
CIRCLE 166 ON READER SERVICE CARD

Electric Hoists . . .

(*Continued from page* 140)



driven trolley mountings, with standard or low headroom arrangements, as well as base, wall, ceiling and deck mountings. Lifting speeds, according to model, range from a low of 10 to 20 fpm to a high range of 20 to 100 fpm. Heights of lifts offered range from 15 to 100 ft according to requirement.
Harnischfeger Corp, Milwaukee 46, Wis. (21)



Splice Kit . . .

. . . for plastic-covered cable contains all material required for splicing a joint. Included in each kit is a housing made from a durable composition of synthetic rubber and thermoplastic resins. The housing resists acids, alkalis and oils and is not harmed by water. Kits are available for making two, three and four-way splices, and each kit contains all material needed for splicing a joint.
G&W Electric Specialty Co, 3500 W 127th St, Blue Island, Ill. (22)

(More New Equipment on page 145)

How to "specify" splices that will last as long as the cable

You can specify "failproof" splices by specifying the same kind of insulation for the splice that you do for the cable.

The compound used for insulating a cable is specifically designed for its job. Therefore, when a portion of the insulation is removed in making the splice, it stands to reason that the insulation should be replaced with the same material—with a true cable-insulating compound.

Fortunately, there are splice insulating tapes made of true cable compounds. They're Okonite and Okolite tapes. Made from fine Para rubber, unexcelled for physical characteristics, Okonite and Okolite tapes fuse into a solid, layerless, non-porous wall of insulation that has excellent moisture resistance, no voids to cause failure, and no adhesives to dry out, ooze, or cause slippage of the tape wrappings. Okonite and Okolite actually become an integral part of the cable's insulation, not a weak "link" in it.

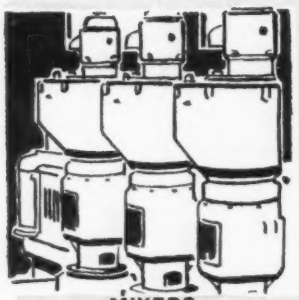
Like to try some of this tape? Let Okonite pay for your first roll. Ask for either or both of the tapes. Just fill in this coupon and send it to Okonite.

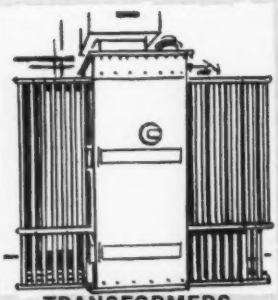
The OKONITE Company
Subsidiary of
Kennecott Copper Corporation
Passaic, New Jersey

Dept. EW 6
The Okonite Company
Passaic, New Jersey
Please check one or both.
.....Okonite tape (yellow can—for use up to 2000 volts).
.....Okolite tape (red can—for use up to 35,000 volts).
Name .....
Title .....
Company .....
Address .....
City .....Zone....State .....

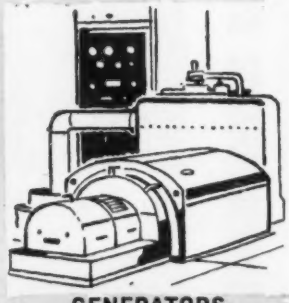
CIRCLE 107 ON READER SERVICE CARD

Which of these common fire hazards threaten you?

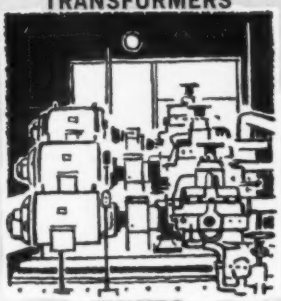

MIXERS

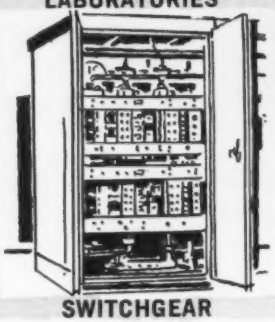

TRANSFORMERS

LABORATORIES


GENERATORS

DRYERS


PUMPS


SWITCHGEAR

VENTILATING DUCTS

If your plant has one or more of these common fire hazards, ordinary fire protection may not prove adequate! You also need special fixed-type protection that constantly guards specific highly hazardous areas!

C-O-Two Fire Extinguishing Systems are specially designed for closed or partially-closed spaces in which highly flammable liquids or solids are manufactured, handled or stored . . . or where there is fixed or rotating electrical equipment. The C-O-Two line includes dependable, high-quality carbon dioxide, dry chemical or foam systems to extinguish fire, plus detecting systems to detect and locate fire automatically.

Your experienced C-O-Two representative is well qualified to carefully analyze all special hazards. Because he offers the industry's largest line of fire protection products and services, he can make equipment recommendations without prejudice. Each C-O-Two System is carefully engineered and manufactured . . . and C-O-Two will also expertly install the system, if desired.

Why not review your common fire hazards now? If protection is either lacking or inadequate, you can confer at no obligation with your nearby C-O-Two Industrial Fire Protection Engineer! Call him today at these offices:

Typical bank of C-O-Two Systems carbon dioxide cylinders.

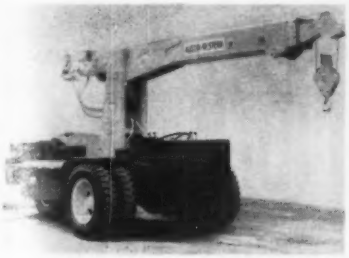
products of
THE FYR-FYTER COMPANY

ATLANTIC COAST REGIONAL OFFICE
P.O. Box 750, Newark 1, New Jersey
CENTRAL STATES REGIONAL OFFICE
221 Crane St., Dayton 2, Ohio
PACIFIC COAST REGIONAL OFFICE
132-140 Hawthorne St., San Francisco 7, California

BRANCHES: Atlanta, Baltimore, Boston, Chicago, Dallas, Dayton, Detroit, Los Angeles, New York, Newark, Philadelphia, Pittsburgh, Portland, Rochester, San Francisco, Seattle, Toronto (Ontario). Representatives and Distributors in all principal cities.

Safety Prods . . .

. . . **rated at 5 kv and 1 amp** are of light weight. Slender ⅛-in. prod extensions are spring loaded, and automatically retract into the insulated housing when released. Non-twist connection at prods prevents premature lead breakage and kinking. **Slaughter Co, Piqua, Ohio. (23)**

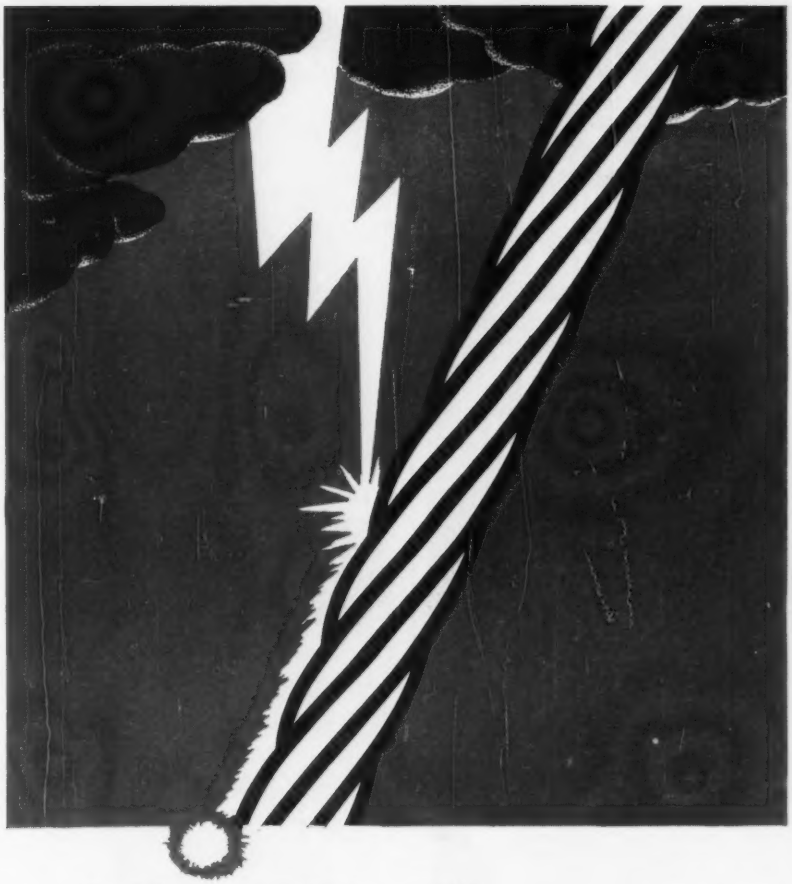


Self-Propelled Crane . . .

. . . **features three-wheel design** with dual front driving wheels and a single rear power booster steerable wheel. Four basic options are available to tailor the crane to any job in the 3 to 5-ton range. The Model-110 can be furnished with hydraulic cable hoist requiring manual boom topping, hydraulic boom topping with a 6-ft extension, hydraulic telescoping boom, or optional swing mechanism which rotates the boom through 220 deg. **Austin-Western Div, Baldwin-Lima-Hamilton Corp, Box 221, Aurora, Ill. (24)**

Fire Extinguishers . . .

. . . **of 10, 15, and 20-lb capacities** have highest UL ratings for their respective capacities.
(*Continued on page* 146)



Safely grounded...with

CF&I Galvanized Steel Strand

The CF&I Image—a giant steelman—stands for the dependability that's built into all CF&I steel products. One of them—Galvanized Steel Strand—is a safe, sure way to ground electrical installations and equipment.

Available in seven- or three-wire constructions, CF&I Galvanized Steel Strand is made in accordance with ASTM Specifications A-122 or A-363. In addition, it can be produced to *your particular specifications.*

CF&I Galvanized Steel Strand is also recommended for guy and messenger wire, and is available for quick delivery either from a nearby CF&I warehouse or from your local electrical distributor.

6931

GALVANIZED STEEL STRAND
THE COLORADO FUEL AND IRON CORPORATION

In the West: **THE COLORADO FUEL AND IRON CORPORATION**—Albuquerque • Amarillo • Billings • Boise Butte • Denver • El Paso • Farmington (N. M.) • Ft. Worth • Houston Kansas City • Lincoln • Los Angeles • Oakland • Oklahoma City Phoenix • Portland • Pueblo • Salt Lake City • San Francisco San Leandro • Seattle • Spokane • Wichita

In the East: **WICKWIRE SPENCER STEEL DIVISION**—Atlanta • Boston Buffalo • Chicago • Detroit • New Orleans • New York • Philadelphia

CF&I OFFICE IN CANADA: Montreal

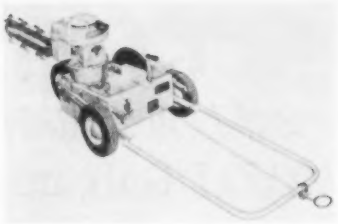
CANADIAN REPRESENTATIVES AT: Calgary • Edmonton • Vancouver • Winnipeg

Fire Extinguishers . . .

(*Continued from page* 145)

The carbon dioxide units are available in either trigger or squeeze-valve actuating mechanisms. The new hose-horn assemblies are also being offered as replacement items.

Walter Kidde & Co, Inc, Belleville, N. J. **(25)**



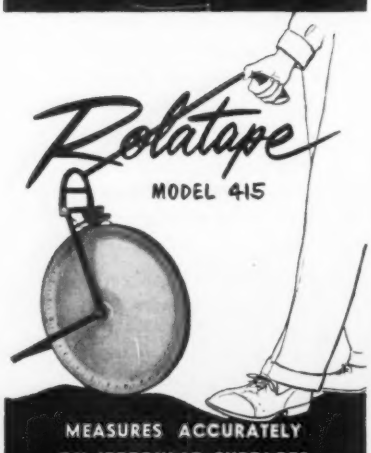
Trencher . . .

. . . **is self-propelled;** once it is started trenching, an operator is needed only to turn the machine off. Known as the Davis Pup, the unit digs trenches from 2 to 3 in. wide to depths of 3 ft. It

It's New!

NOW—AT LAST A MEASURING WHEEL THAT MEASURES ACCURATELY TO A FRACTION OF AN INCH!

Rolatape's amazing new Model 415 meets all your measuring needs — measuring quickly and surely over the most uneven and irregular terrain with no risk of human error. This time-saving instrument is calibrated to measure accurately in full view of operator as it is rolled along, giving measurements in inches (to ½ inch) on one side of measuring wheel, and tenths of a foot (to .5 of a foot) on the other. Sturdy and lightwight, it is equipped with automatic brake and built-in stand. Handle folds compactly. See one at your dealer's today.



MEASURES ACCURATELY ON IRREGULAR SURFACES

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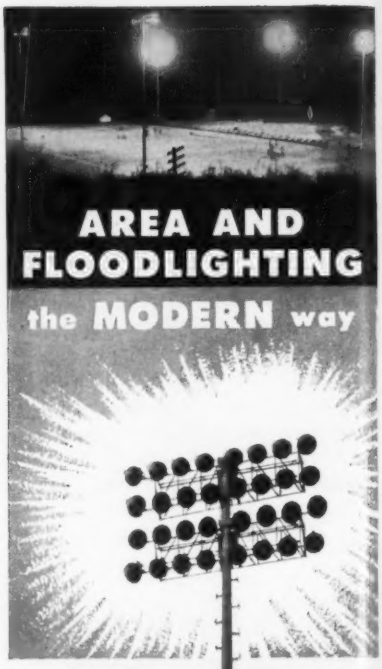
NOW... TROUBLE-SHOOT TROUBLE SPOTS *FAST*
Save valuable Kw-hrs.

DICE MICROHM METER

Favorite of leading utilities for all low-resistance measurements on material tests, circuit breaker contacts, bus bar connections, cable joints.
MEASURES DOWN TO *ONE* MICROHM!
J.W. DICE CO. ENGLEWOOD, N.J.

CIRCLE 168 ON READER SERVICE CARD



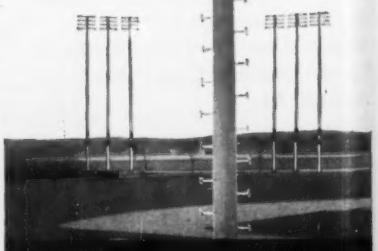
AREA AND FLOODLIGHTING the MODERN way

TULITO

TAPERED STEEL LIGHTING TUBES

For
- Baseball Diamonds
- Football Fields
- Playgrounds
- Shopping Centers
- Truck Terminals
- Railroad Yards
- Race Tracks
- Radio and TV Towers
- Transmission Power Lines

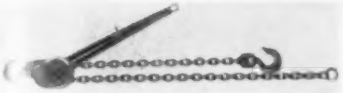
Engineered for Permanence, Strength and Safety . . .
Designed to accommodate from 2 to 40 lights.
Streamlined to enhance the appearance of any lighted area.



MEYER MACHINE, INC.
RED WING, MINNESOTA

CIRCLE 169 ON READER SERVICE CARD

has a positive, variable speed drive with a winching mechanism that draws the Pup down the line to be dug at six different speeds.
Davis Mfg Co, Inc, 1301 S Handley, Wichita, Kans. **(26)**



Pull-A-Way . . .

. . . **in four sizes** handles loads up to six tons. Type C Pull-A-Way is made of aluminum alloy castings, combined with lightweight alloy steel chain, gears and hooks. Both top and bottom hooks are drop forged alloy steel, heat treated to withstand shock loads.
Wright Hoist Div, American Chain & Cable Co, Inc, York, Pa. **(27)**

Storage Battery . . .

. . . **features standardized basic** cells with capacities of 220, 125 and 75 amp-hr. Standardized shock-resistant cell base frames, designed to dovetail on all sides with similar frames, permit cell arrangements to meet practically any voltage, amperage, weight or configuration requirement.
Scranton Cellomatic Battery Corp, Archbald, Pa. **(28)**

Digital Transducer . . .

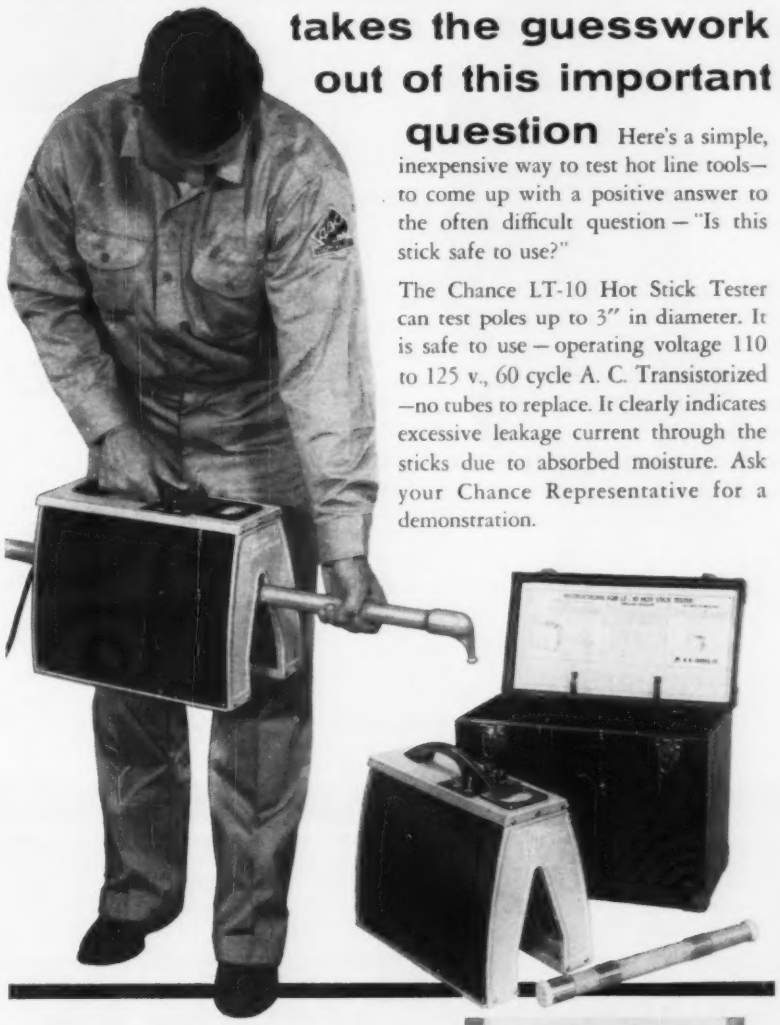
. . . **measures process variables** and provides digital encoding for flow, liquid level, pressure or temperature. The Series 400 transducers are available in vacuum and pressure ranges to 10,000 psi, temperature ranges to 600F, and in mercury or bellows type manometers for liquid level or flow applications.
American Meter Co, Box 309, Garland, Tex. **(29)**

ARE YOUR HOT STICKS SAFE?

Chance Portable Hot Stick Tester takes the guesswork out of this important question

Here's a simple, inexpensive way to test hot line tools—to come up with a positive answer to the often difficult question—"Is this stick safe to use?"

The Chance LT-10 Hot Stick Tester can test poles up to 3" in diameter. It is safe to use—operating voltage 110 to 125 v., 60 cycle A. C. Transistorized—no tubes to replace. It clearly indicates excessive leakage current through the sticks due to absorbed moisture. Ask your Chance Representative for a demonstration.

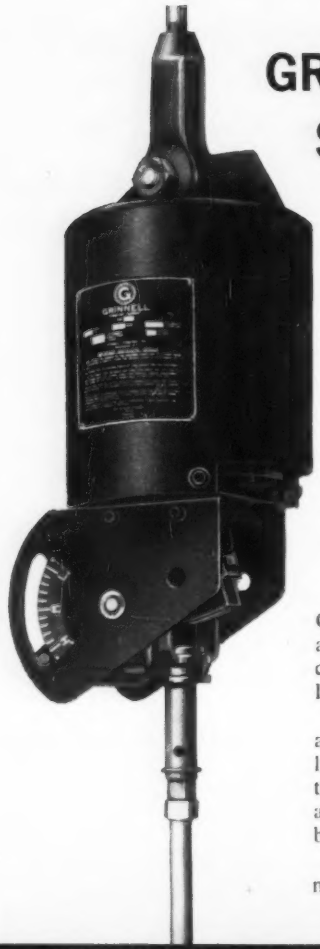


EASY TO OPERATE. A simple single dial shows whether the tool is safe to use or whether the tool should be dried and re-tested. A number of readings along the pole test every foot for safety.

EASY TO CALIBRATE. You can always be sure that the tester is accurately calibrated. Just press the "PUSH TO CALIBRATE" button and turn "ADJUST" knob until needle is centered on dial. A calibration standard is furnished with the unit for positive double-checking.

A. B. CHANCE CO.
CENTRALIA, MISSOURI
A. B. Chance Co. of Canada, Ltd., Toronto

CH59-16



GRINNELL CONSTANT SUPPORTS...

2 BASIC DESIGNS...

11 DIFFERENT METHODS OF ATTACHMENT

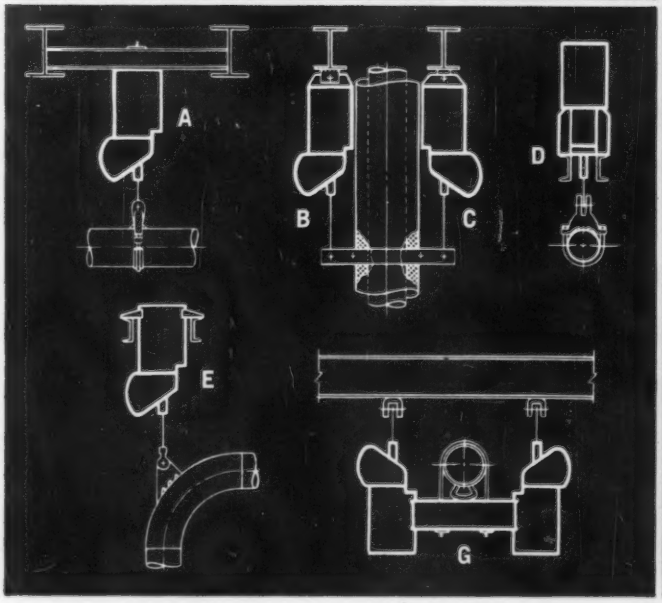
Grinnell Constant Supports are available in a range of sizes to provide capacities for loads from 27 lbs. to 57,500 lbs., with travels up to 16 inches.

Both vertical and horizontal hangers are designed to operate in extremely limited space. In the selection of types, there is a choice of 11 methods of attachment to structures—either above, between, or below supporting steel.

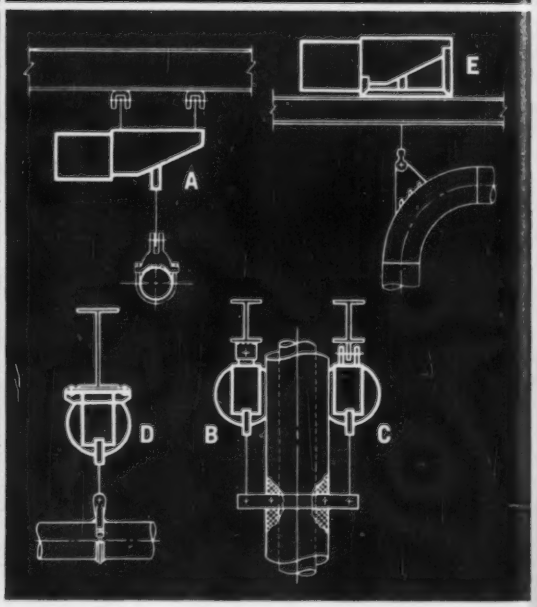
Grinnell Constant Supports provide mathematically perfect load support throughout all positions of travel . . . also a full 70 percentage points of adjustability is built into them. No less than 10% of this adjustability is allowed either side of calibration for plus or minus change in load. Field readjustments are easily made by turning a single load adjustment bolt.

Call on Grinnell's Pipe Suspension Department for help with your pipe suspension problems. Grinnell Company, Providence 1, Rhode Island.

FOR VERTICAL ATTACHMENT



FOR HORIZONTAL ATTACHMENT



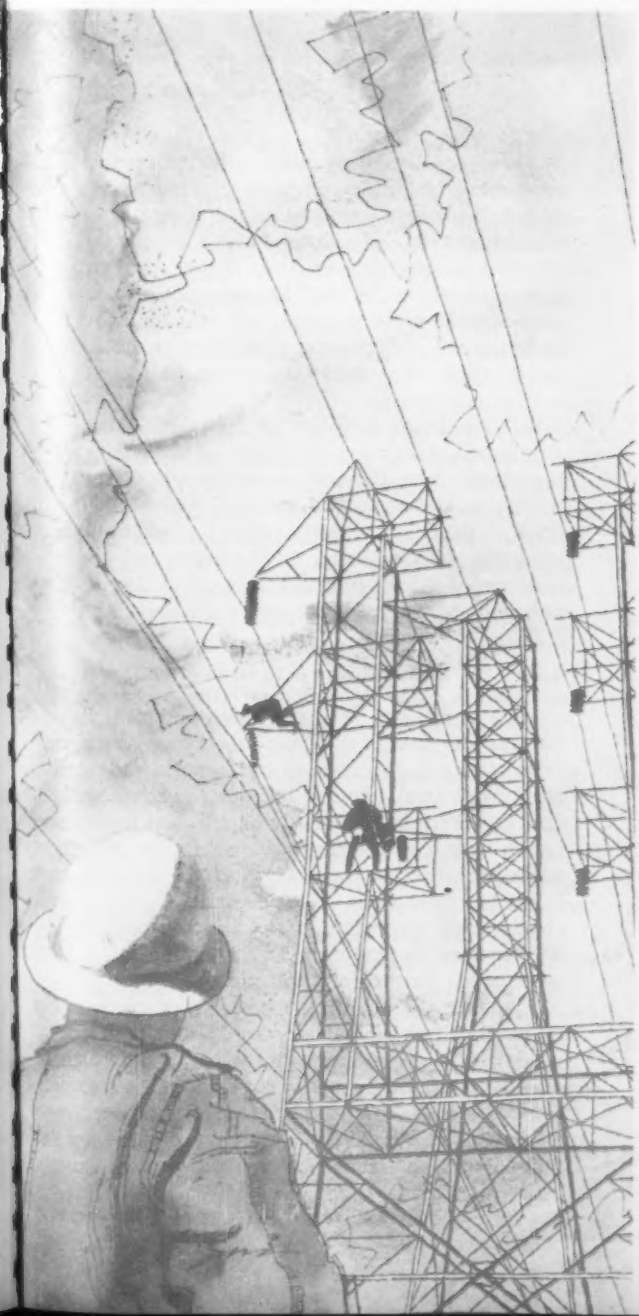
GRINNELL

AMERICA'S No. 1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

CL&P "Shoehorns" 4 Circuits into 80-ft R/W

Construction crews worked closely with design engineers to build four-circuit 115-kv structures around lower-voltage towers

HOWARD HUMPHRIES, *Construction Supt,*
PHILLIP S. DEAN, *Engineering Designer, Transmission,*
Connecticut Light and Power Co, Berlin, Conn.



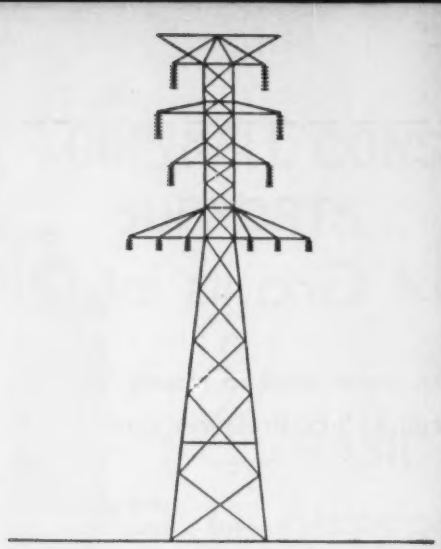
Close cooperation between construction men and design engineers paved the way for Connecticut Light & Power Co to "shoehorn" four circuits designed for 115-kv operation into an 80-ft right-of-way. Attention to construction details was essential because the four-circuit truss-type structures were built around towers carrying four energized circuits, two each of 69 kv and 28 kv, and two ground wires. Design and construction procedures were such that, although the line is of unusual design, only the usual construction problems of winter work and access to rights-of-way in built-up areas had to be met. Major problems were anticipated and virtually eliminated at preliminary meetings involving our design and construction people and the steel fabricator, Bethlehem Steel Co.

Existing right-of-way for the line has an 80-ft maximum width, one section only 50-ft wide, and several restrictions as to tower locations. Load growth indicated the need for three 115-kv circuits using 795-MCM ACSR conductor. New structures were designed to meet NESC standard heavy-loading requirements and 1-in. ice loading. Tangent structures were designed for one broken conductor and one broken aerial ground wire; medium angle towers up to 12.5 deg, two broken conductors and one ground wire; and heavy angle structures up to 40 deg, all conductors and ground wires broken.

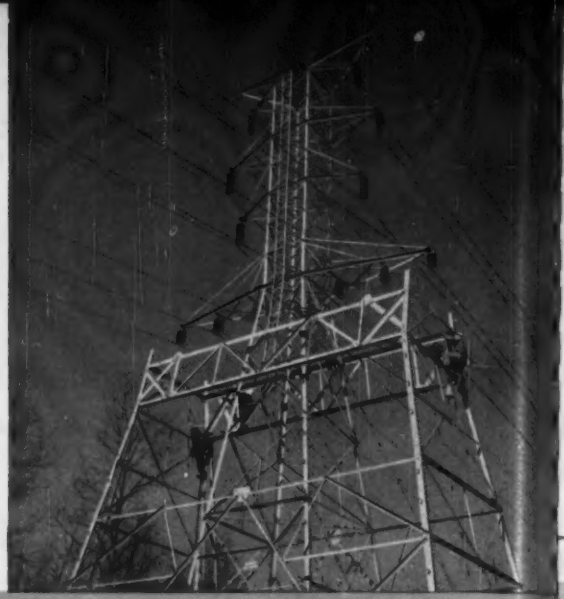
Maximum loading per conductor was considered as 7,000 lb without NESC safety factors. During construction, it was determined that under normal load conditions one 69-kv and one 28-kv circuit could be released from service for limited periods. However, the lines had to be ready for a quick return to service to meet emergencies.

Important factors during construction ranged from installation of foundations through steel erection and conductor stringing. Each tower site was visited by design and construction personnel to set the exact location of all tower foundations. It was evident that if new structures were located as near as possible to existing structures, then existing span lengths and angles would be determining design factors. Spans varied from 300 to 900 ft.

In one instance involving an angle exceeding 40



1 **EXISTING TOWER** on 80-ft r/w carried 69-kv and 28-kv lines



2 **NEW BASES** were erected to within a minimum distance of energized 28-kv lines as first phase

deg, two towers were used to avoid a special design for one location. Company-owned property at this location made it easier to shift tower sites.

First design considerations were given to use of two narrow-base towers, opposite each existing tower, with trusses installed after the removal of the old tower. However, preliminary design by the steel fabricator showed that overturning moments of the bases of these towers were too large for normal foundations. In addition, required angle sizes would have made steel costs uneconomical. The alternate design of wide-spread open-lattice type four-legged towers resulted in more reasonable foundation dimensions and less use of steel. For heavier angle towers, the steel fabricator suggested medium manganese steel for main members to reduce weight. It was found economical to follow this pattern on all towers. Weight of towers varied from 21,000 to 39,000 lb.

The first problem in construction was the placing of new foundations, which would straddle footings of the existing towers. Close supervision of the contractor installing the foundations was necessary to prevent possible undermining of original footings during excavation. Some existing towers were guyed temporarily; in some cases only two footings were dug at a time. Blasting in rock for 25% of the excavating under four operating circuits was an added complexity.

To erect as much steel as possible without removing any lines from service, a minimum distance below elevation of the 28-kv conductors was determined from existing tower dimensions (Illustration 1) as the maximum height for the first section of the new tower. The truss at this elevation had to straddle the main body of the old tower both transversely and longitudinally (Illustration 2). It also had to support two columns to carry conductors until trusses could be installed.

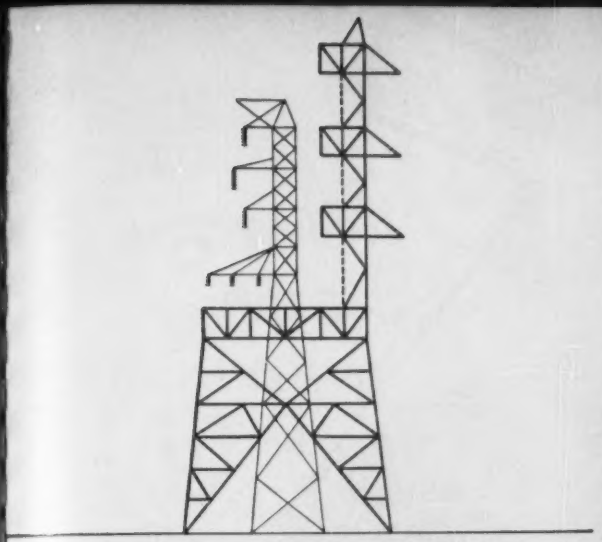
These columns were essentially the outside legs supporting the arms with temporary vertical members added. Members were designed for heavy loading of existing 4/0 copper conductors. After trusses were installed, these members were removed to give required clearance for 115-kv operation. Length of steel handled in the proximity of live conductors was an important consideration. Thus, for greater safety, more splices were used than would be required on normal construction.

New steel was delivered to the right-of-way with a standard line truck with hydraulic boom and a four-wheel-drive flat-body materials truck. The line truck loaded longer steel members on the flat-body truck at the central storage point, the line truck carrying the shorter pieces. At the lower site, the line truck unloaded the material adjacent to the working area and also set the lower legs, each weighing about 800 lb.

Spot Crews According to Skills

With a number of first sections erected, it was necessary to release one 28-kv and one 69-kv circuit from service for erection of one column and outside arms. With steel men and linemen working together, crews worked simultaneously on adjacent towers and could have circuits ready for operation on short notice. Each crew was spotted at the location best suited to their skills. For example, a tower with considerable wire work, such as a dead end, drew a line foreman and crew; a location with a lot of steel work called for a chief mechanic and crew.

The first column of the new tower carried one 69-kv circuit on the outside, one 28-kv circuit on the inside, and a ground wire on the peak. Before these circuits were energized, old tower arms on one side were removed (Illustration 3). After the load was transferred to the 69-kv and 28-kv circuits on the first column, the second column was erected exactly



3 **FIRST COLUMN** of new tower carries 69-kv line on outside, 28-kv on inside, and ground wire at peak

4 **SECOND COLUMN** is identical with first, but carries 69-kv line on inside; 28-kv on outside

as the first except that the 69-kv circuit was installed on the inside and the 28-kv circuit on the outside of the column (Illustration 4).

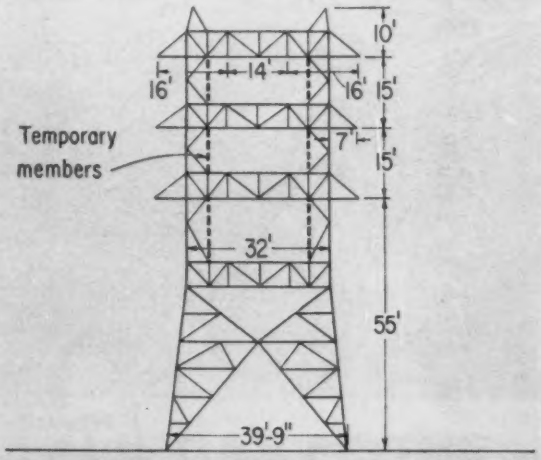
This was accomplished by temporarily tieing the de-energized 69-kv circuit inside and the de-energized 28-kv circuit outside the second steel column during erection. When steel work was completed on the column, the de-energized circuits were placed in their permanent positions. This provided a circuit arrangement of 69-28-69-28-kv from left to right.

This location of circuits on the new towers provided four combinations of two circuits (one 69-kv and one 28-kv) which could be energized during construction. This was most desirable as there were several crews working on this project and coordination of work was imperative for maximum safety. One foreman could handle circuit clearance from the load dispatcher and also give general supervision to crews working on adjacent towers.

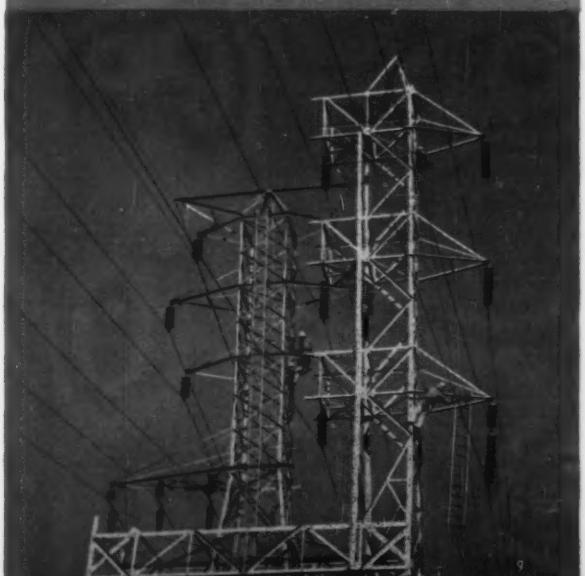
With the outside 69-kv circuit and the outside 28-kv circuit energized, the top truss was installed and then used in lowering the old tower in pieces to a position that gave operating clearance.

Temporary tower members removed after the truss installation were used on other line sections as work progressed (Illustration 5). They were scrapped when all towers were completed. Cost of temporary members averaged about $300 per tower for material; installation and removal cost was much less than the equivalent cost of temporary poles.

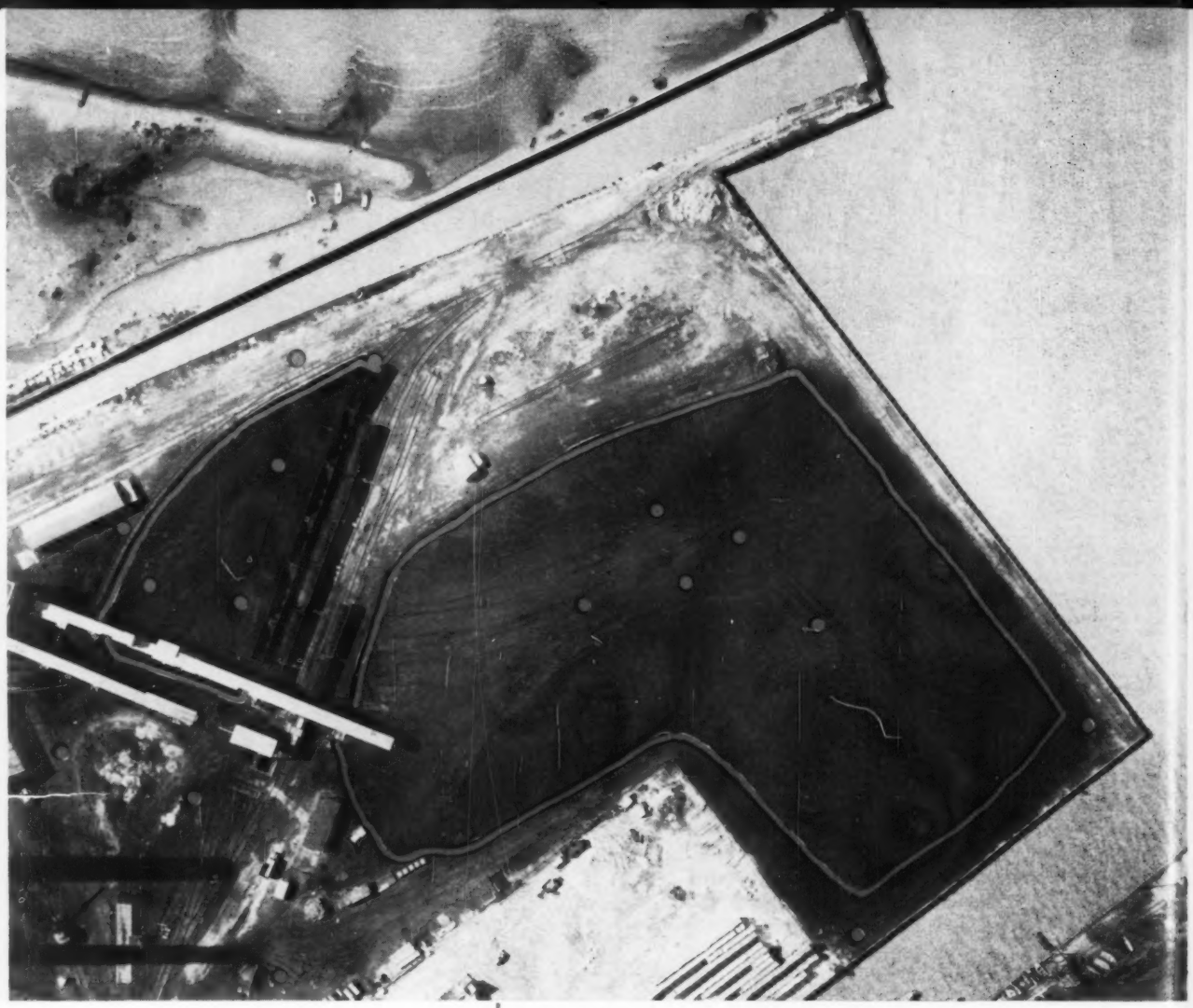
Each line crew was equipped with tools, including a line truck with front-end cable winch. This winch raised and lowered all steel, insulators and wire beyond the capacity of a hand line. Final phases of construction were the reinsulation of conductors, and replacement of old conductor with 795-MCM ACSR conductors on three circuits. The fourth circuit will not be reconductored for a number of years.



5 **MEMBERS** were used, from tower to tower as work progressed, until trusses were erected



6 **TWO CONDUCTORS** with insulators were hung on arm temporarily during transfer of circuits



PERMANENT CONTROL POINTS around the perimeter and temporary points on the coal, plus an outline of the piles, are marked with lime

Accurate Controls Aid Aerial Survey of Coal

D. B. ZELENKA, *Production Technical Engineer*

W. R. FORSYTH, *Production Results Engineer, Ohio Edison Co, Akron, Ohio*

Aerial photographs, complemented by accurate control procedures, help Ohio Edison Co maintain adequate coal storage inventories. The method has proven economical, time saving, and within acceptable limits of accuracy. This method has been found successful for coal densities ranging from 50 to 75 lb per cu ft.

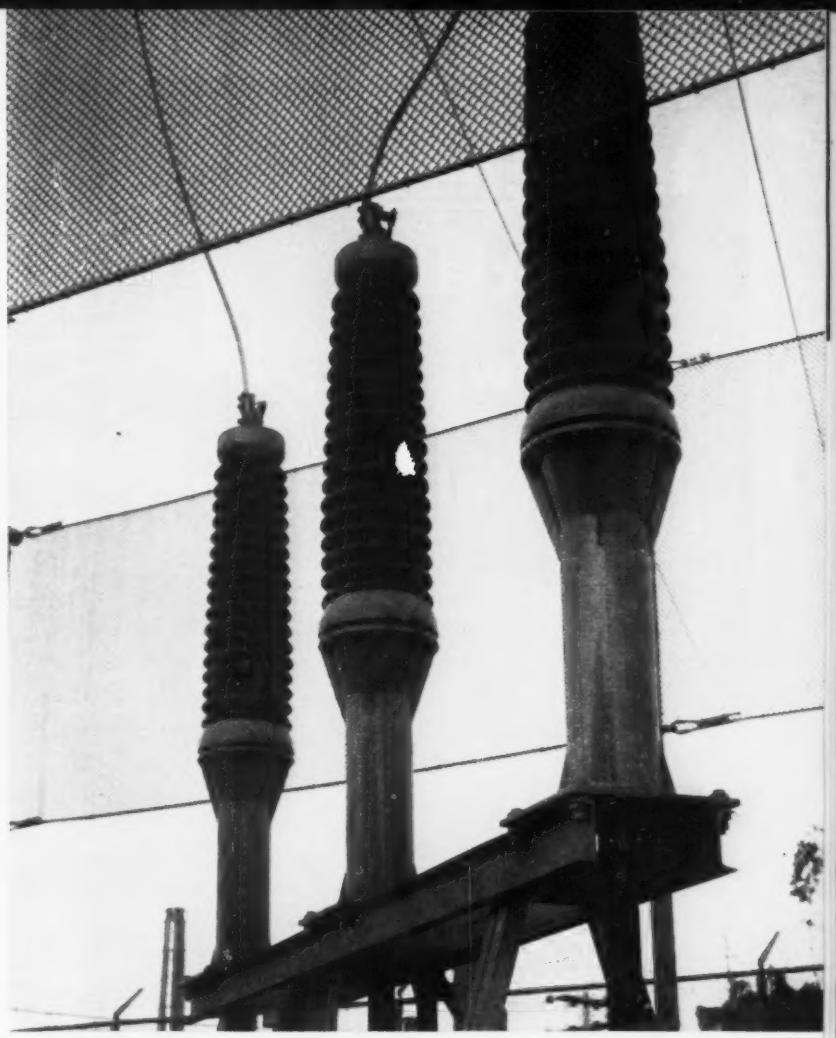
Control procedures begin with at least five permanent control points, readily visible from the air, and located by ground survey around the perimeter of the coal storage area. They are located by a closed traverse showing the horizontal distance between each, as well as elevation of each. With five or more points it is easy to find an error in the elevation of any one point. These points are considered permanent and are used in all surveys.

Five temporary control points are established on the top of the coal pile. Only the elevation for each temporary point is required. It is then compared with an elevation determined by the photogrammetric method. Each year new temporary control points are determined. All temporary and permanent control points are marked by a 3-ft circle of lime so that they may be identified on the aerial photograph.

(*Continued on page* 155)

ANOTHER FIRST from G&W

"a significant step forward in the termination of high-voltage cable"*



The first use of a commercially available

138 kv HIGH PRESSURE ALL-GAS POTHEAD

in which the porcelain is subjected to full line pressure

The very first pothead to be used commercially was designed by the founders of G&W. Over fifty-five years later and many other "firsts," G&W engineers have produced the most complete line of potheads available to industry. You can specify the pothead of your choice with utmost confidence.

G&W experience, engineering skill, and the manufacturing resources at its command are second to none. They are your positive guarantee of satisfaction.

Write today for your copy of "MORE POWER DOWNTOWN".

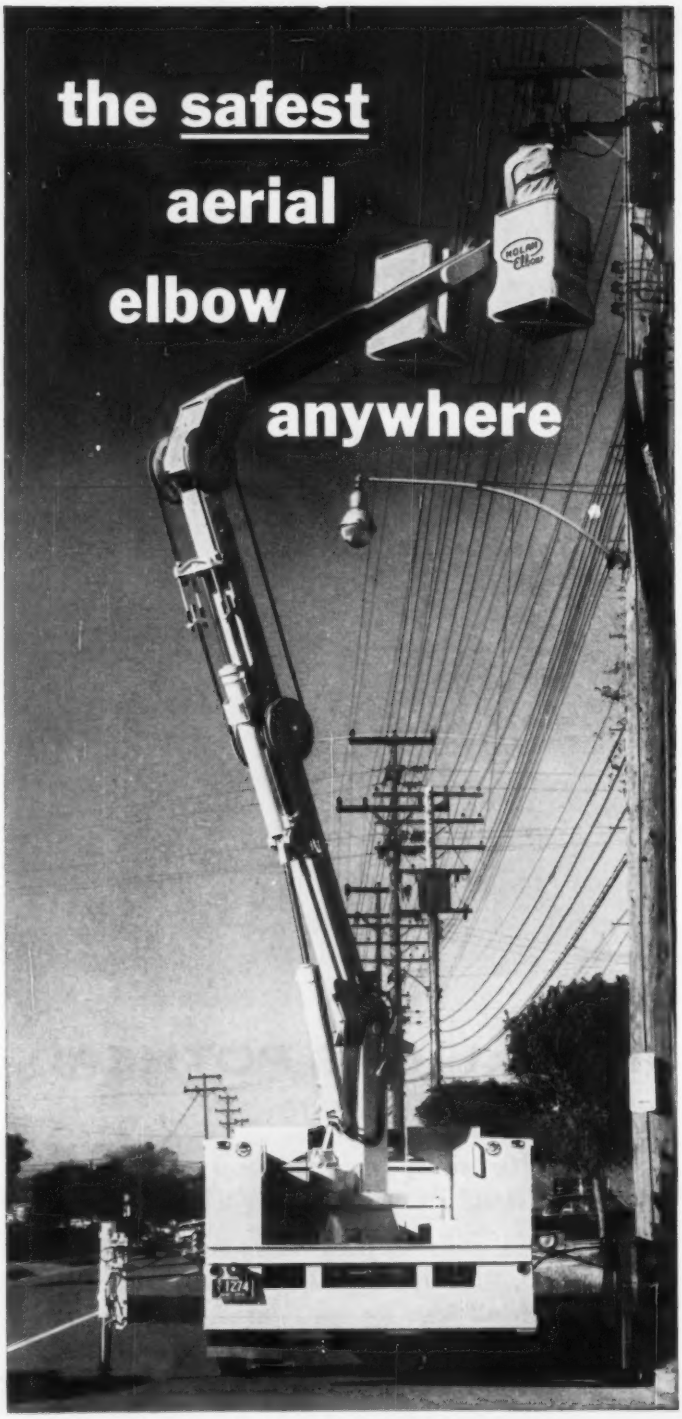
* *This quote is from an authoritative article titled, "More Power Downtown". The article gives full facts on new ideas used in the construction of a 110 kv underground system on the West Coast. Describes techniques you'll want to know about—"must" reading. Send for your copy today.*

G&W ELECTRIC SPECIALTY CO.

3500 W. 127th Street • Blue Island • Illinois

Canadian Mfr. —Powerlite Devices, Ltd., Toronto, Montreal & Vancouver

CIRCLE 117 ON READER SERVICE CARD



Holan fiber glass section in upper arm

Holan Elbow has precise aircraft-type cable controls and strong, non-conductive fiber glass section in upper arm

With a Holan Elbow, it's easy to get to the problem—and safe when you get there.

The exclusive cable control system provides easy, precise spotting of the buckets. And a fiber glass section in the upper arm insulates workmen in the buckets from the ground.

The fiber glass section is solid—*not* metal enclosed with fiber glass. Also, control cables and leveling cables have fiber glass inserts so that men in the bucket are completely separated from metal-to-ground contact. In a bucket-to-ground test, the non-conductive fiber glass section withstood 100,000 volts for one minute.

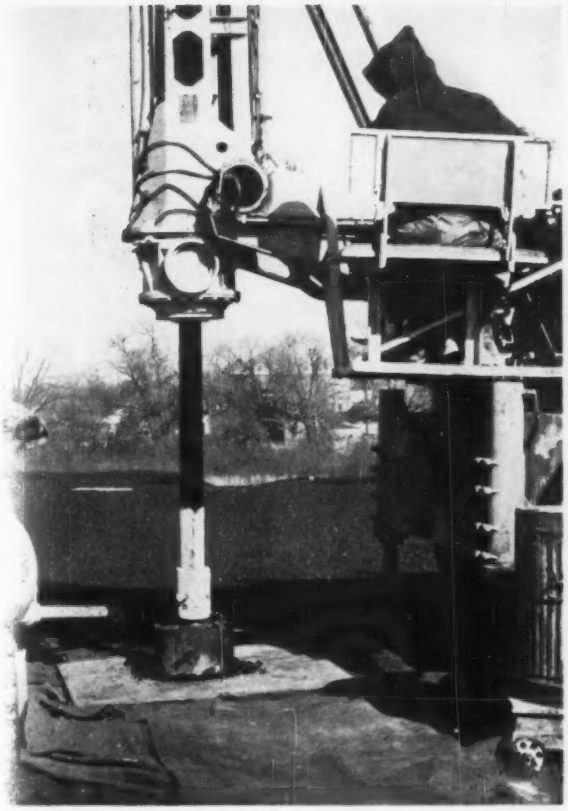
As for strength, in a separate test the fiber glass section required a 6,200-pound load at end before failing. This is a safety factor in excess of 7 as nominal capacity and weight of the buckets total 800 pounds.

Safety does come first but there are many operating features to talk about, too. Write for all the details.

Holan Corporation, 4100 W. 150th St., Cleveland 35, Ohio
Plants in: Cleveland, Ohio; Griffin, Georgia; Phoenix, Ariz.

Holan

Subsidiary of THE OHIO BRASS COMPANY



Left — COAL taken from hole measuring about 16 in. in diameter and 15 ft deep is collected and weighed

Above — VOLUME is found by inserting a thin rubber bag and filling with water to the level of the coal

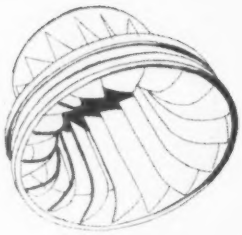
Below — COAL DENSITY is found from weight of coal and volume of water corrected for the bag thickness

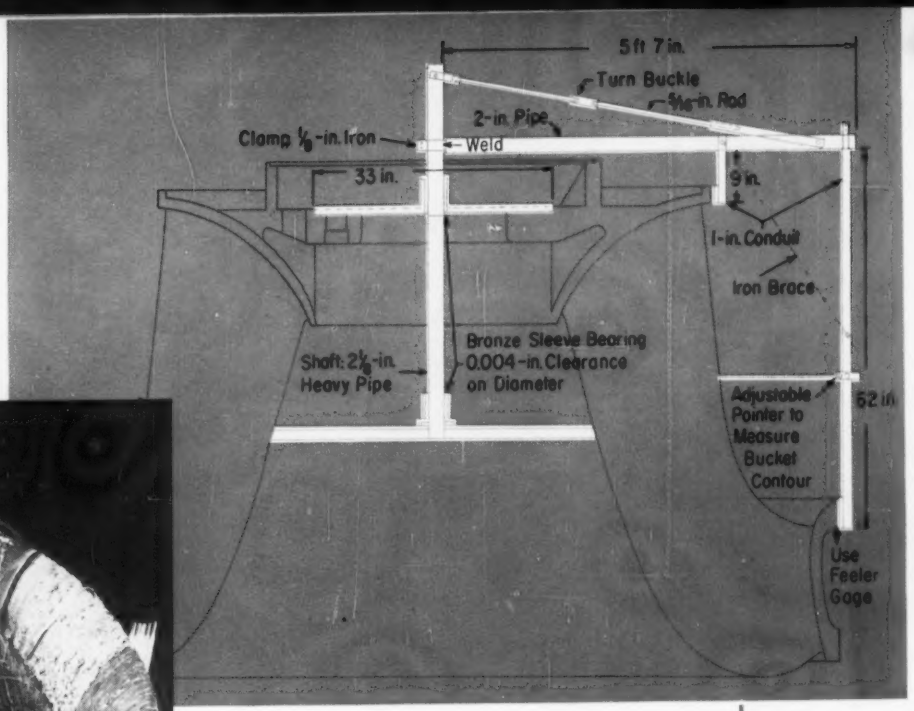
The line of demarcation between the coal pile and ground is marked by a strip of lime. This clearly outlines the area containing coal. The location is otherwise difficult to ascertain on an aerial photograph, due to dust and ashes surrounding the pile.

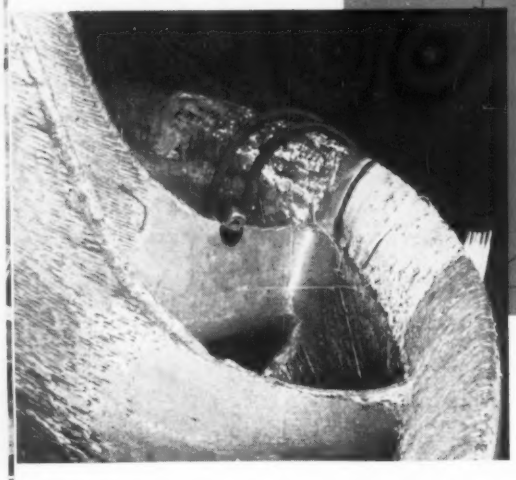
Coal pile density is determined by the auger-rubber bag method. Sample test holes are bored throughout the coal pile. Holes are made with a 14-in. diameter bucket auger attached to a conventional hole-digging rig of a line truck. The coal removed from each hole is collected and weighed. Each hole is about 16 in. diameter and up to 15 ft deep.

The volume of the hole is determined by first inserting a rubber bag 16 in. diameter x 16 ft long x 0.010 in. thick and weighing the water required to fill it to the coal level. Sometimes two bags are used; the outer one, which need not be water-tight, protects the inner water-tight bag from abrasion. By determining the water volume and correcting for the bag thickness, the coal density may be calculated. Weight-averaging of the results from each test hole will produce a reasonable approximation of the overall stock pile density.

Before the rubber bags are withdrawn, the water is pumped out and returned to its original container by a portable gasoline-driven pump.







EDGES OF BUCKETS were returned to original contour with stainless steel overlay. Truth gage (above) measured overlay on runner seals

Truth Gages Aid Overhaul of Hydro Unit

ROBERT M. LEAHEY, *Staff Engineer, Power Production Dept, West Penn Power Co, Greensburg, Pa.*

Restoration of a water wheel and distributor rings was facilitated through use of truth gages built by maintenance crews of West Penn Power Co. The gages speeded major overhaul of an 18,000-hp, 133.3-rpm unit. The crews also used a new method for checking generator shaft alignment.

Following a period of partial repair of four identical hydro generators with vertical Francis turbines at West Penn's Lake Lynn hydroelectric station, it was decided in 1957 to restore No. 4 unit, which was in greatest need of major overhaul. Starting with this unit, new procedures were followed to restore the water wheel and generator to peak operating efficiency. Because the new procedures for determining generator shaft alignment, diameter of runner seal ring, and final diameters of the distributor rings were of greatest value, this article will be limited to these maintenance features.

Severe misalignment of No. 4 unit's generator shaft was indicated by uneven and excessive wear of the No. 3 (water wheel) guide bearing. This method was used to check the shaft for truth to determine the cause of misalignment.

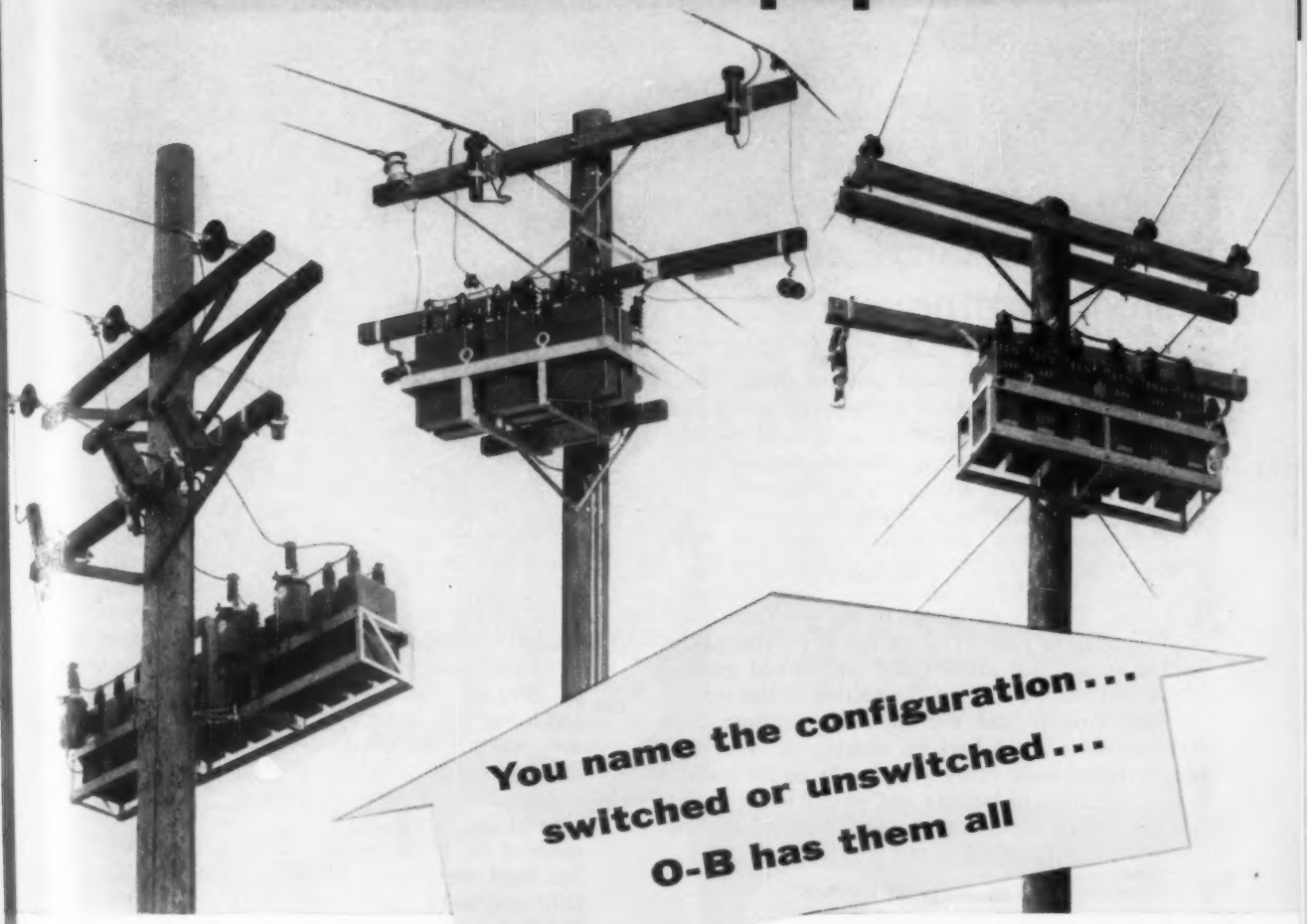
The generator and water wheel guide bearings were removed and the shaft uncoupled. Dial-type micrometers were placed along the shaft in four planes, four micrometers per plane. Eight micrometers were contained in a north-south vertical plane and eight in an east-west vertical plane through the shaft. Horizontal micrometer planes were located at the thrust collar, just below No. 1 generator guide bearing, just above No. 2 generator guide bearing, and on the generator coupling flange.

A chart was set up with 0, 90, 180, 270, and 360-deg rotations in column form on the horizontal axis and the four micrometer planes on the vertical axis. Initial north, south, east, and west readings in each micrometer plane were recorded under the O-deg column. The shaft then was rotated 90 deg four times with micrometer readings recorded for each shaft position. Plotted net values of shaft runout showed the generator shaft to be true but skewed in relation to the thrust collar. A maximum runout of 0.064 in. was measured at the coupling. It was concluded that movement had taken place between the thrust collar and the shaft's thrust collar shoulder.

With the rotor lifted onto the power station floor,

(*Continued on page* 158)

Buy VAREX® In Your Choice of Pole-Mounted Equipments



We won't challenge you to specify a pole-mounted equipment arrangement that O-B can't supply. You might outguess us but there are literally thousands of combinations to choose from. Basically, you can have in-line, rectangular and cluster arrangements -- switched or unswitched, with your choice of switch manufacturer, and any number of units from 1 to 24.

There are a few points to make concerning the rack designs. Although the equipments are shipped on wooden skids, they are designed so that the lower frame members constitute a skid in themselves. The "boxed-in" style of the rack provides a permanent shield for the entire equipment.

Now for the convenience features. Our engineers know, for example, that linemen treat lag screws like nails, driving them into the pole when an equipment is mounted. So mounting brackets are arranged to give the lineman plenty of room for a full swing at the screw heads.

We also have rubber caps for capacitor and switch terminals, big lifting eyes, 5-kv insulated cable and any other quality feature you'd like to name. But despite these features, the big advantage is the Varex unit that goes into the equipment -- foil-cooled, stainless steel terminal studs, spring pressure contact on elements, low height, and with O-B's own wet process porcelain bushings in a compression assembly that assures leak-free operation. Regardless of the equipment you choose, you get the full range of Varex advantages.

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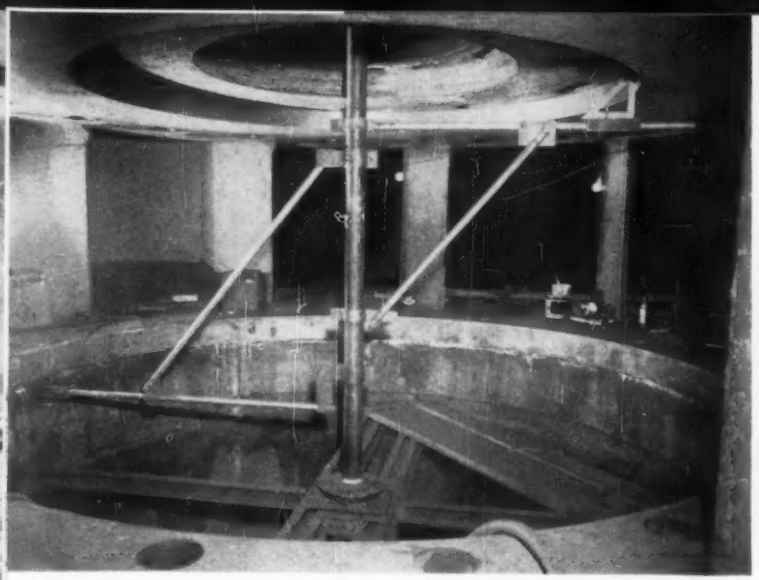
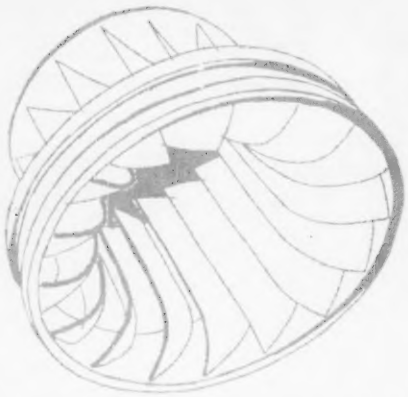
CIRCLE 127 ON READER SERVICE CARD

4969-H





TRUTH GAGE mounted inside distributor made possible the grinding of stainless steel rings to a tolerance of +0.008 in. on the radius

the thrust nut was removed, and the thrust collar disassembled. The shoulder of the shaft was found to be true, using the machined surface at the top of the shaft as a reference. Because the key ways in the collar were worn unevenly, they were machined oversized, and new oversized keys installed.

The reconditioned thrust collar and nut were reassembled and dial micrometer readings were taken as before. A 0.004-in. runout was observed at the coupling. The bottom flange of the generator shaft was found to be parallel by the use of parallel gages.

The runner was sand-blasted and turned upside-down to facilitate welding. Inspection of the runner showed erosion and corrosion on pressure and vacuum sides of the buckets; wearing on lower and upper runner seals; many large cracks on the trailing edges and fillets of buckets and several small cracks on the leading edges; and a crack about 12-in. long completely through the runner hub.

Buckets Returned to Original Contour

Restoration of the runner included chipping of all cracks, initial welding of cracks with low-hydrogen, high-strength rod, and addition of strengthening plates to the pressure side of each bucket and the six sections of the runner's crown. The cracks, pressure and vacuum sides of the buckets, and the inside diameter of the bottom cylindrical part of the runner then were overlaid with 18-8 stainless steel. A $\frac{3}{32}$-in. to ½-in. overlay returned the buckets to their original contour. Upper and lower runner seals were built up with a stainless steel overlay of ¾-in. and ½-in. respectively. The runner was stress-relieved and seals turned at an outside machine shop.

A runner truth gage was designed to measure the overlay on upper and lower seals to insure sufficient weld for final machining. Spigot fit of the runner and runner shaft was used to center the top bearing of the truth gage. The runner was plumbed on the power station floor with a machinist level. Cross plates with a centered bearing support were welded, machined concentric, and installed in the spigot fit.

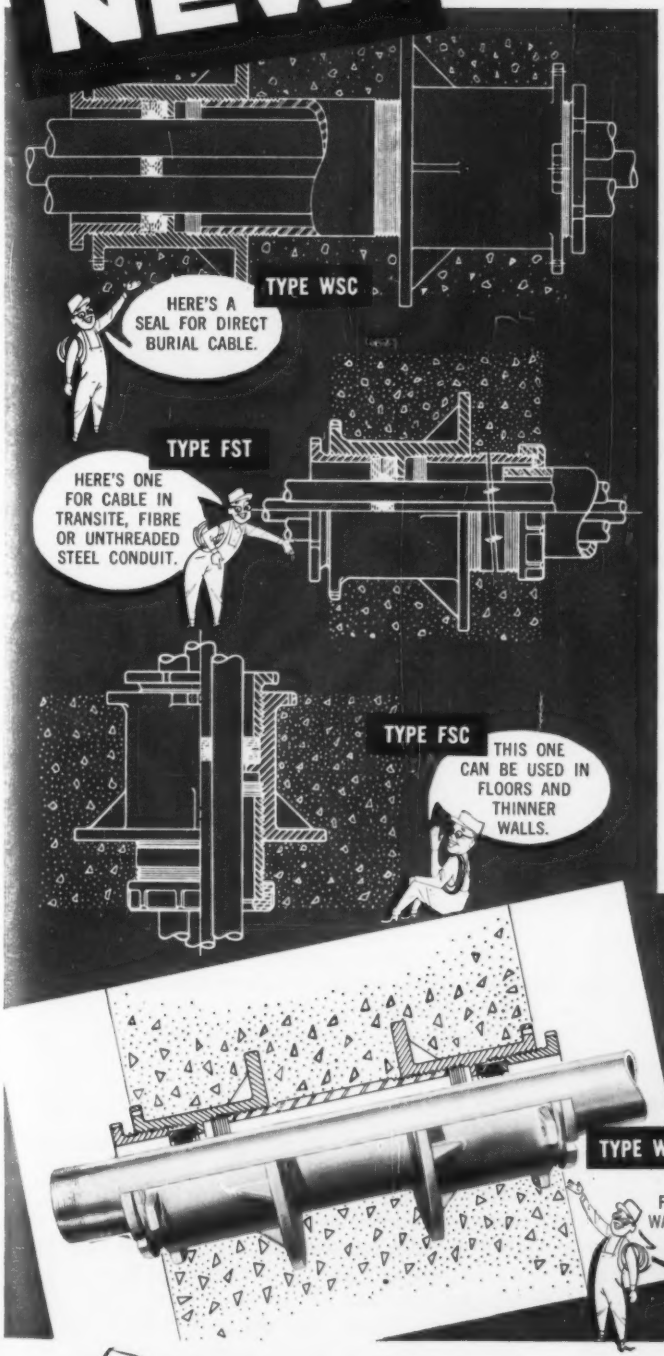
Two cross rails were welded to the buckets at the vertical center of the runner 6 ft below the spigot fit. An adjustable lower bearing support with a centered 0.028-in. hole was installed on the cross rails. A 0.022-in. piano wire was hung from the center of the top bearing through the 0.028-in. hole and held taut and damped by a weight suspended in oil. An electrical circuit including a light, the adjustable plate, and the piano wire was set up. By proper movement of the plate, the piano wire cleared the center of the hole, causing the light to go out. This located the center of the bottom bearing support.

Bronze sleeve bearings, having 0.004-in. diametrical clearance, were installed in the centered upper and lower bearing support. A shaft with a swinging arm was then installed in these sleeve bearings to take measurements on the buckets and runner seals.

Inspection of top and bottom distributor rings showed the cast iron to be extremely porous. Because of the lower cost, it was decided to use stainless steel wear rings, rather than overlaying with mild steel and stainless steel. First, upper and lower distributor rings were chipped and ground to a ½-in. depth with a + 0.007-in. tolerance on the radius. Rings were rolled from 304 stainless bar stock to within ± 0.010 in. on the diameter and delivered in halves. Standard course thread machine screws of 18-8 stainless steel placed and center-punched in double rows at 10-in. centers around the circumference held the rings in place. Because heat distortion prevented satisfactory welding of the butt ends, ring joints were filled with cyprus wedges.

Rings were ground by hand with water-cooled grinders to a tolerance of + 0.008 in. on the radius. Accuracy in grinding was made possible by use of a truth gage, similar to the type described above. Center of the gage was established using No. 3 bearing fit in the headcover as a reference. Adjustable plate for the lower bearing pedestal was mounted on cross rails resting on and welded to the ledge at the draft tube entrance. Two swinging arms were mounted on the center shaft of the gage, each equipped with a micrometer for measuring upper and lower distributor ring clearance.

NEW! a complete line of O.Z. WATERTIGHT ENTRANCE FITTINGS for Conduit or Cable


TYPE WSC
HERE'S A SEAL FOR DIRECT BURIAL CABLE.
TYPE FST
HERE'S ONE FOR CABLE IN TRANSITE, FIBRE OR UNTHREADED STEEL CONDUIT.
TYPE FSC
THIS ONE CAN BE USED IN FLOORS AND THINNER WALLS.
TYPE FSK
TRY THIS FOR SEALING CONDUIT IN FLOORS AND WALLS.
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Diesel, the low-cost, widely-available, easy-to-handle fuel, is standard for Alouette consumption. Now the modern, cost-conscious Alouette operator has a choice of four fuels . . . JP-1, JP-4, 640 Kerosene . . . and diesel. Such fuel flexibility is unmatched by other operational helicopters.*

Jet-powered Alouette's dependable versatility, and its compatibility to diesel fuel . . . found almost anywhere . . . make a daily routine of operations in areas that up to now were all but inaccessible.

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FARMINGDALE, LONG ISLAND, N. Y.

CONSTRUCTION

Push Small Pipe Accurately With Winch Line

Small pipe is being pushed under sidewalks, driveways and streets by Houston Lighting & Power Co crews with a push-pull method that gets its power from the winch line. The method pushes pipe up to 3 in. in diameter five times as fast as a hydraulic pusher and is just as accurate.

The pushing equipment consists of two steel members that mount on a stake-body winch truck and a set of steel pulleys. The steel members are adjustable vertically for pushing at different depths. The entire unit swivels at truck bed level so that at its high position it can be laid in the truck for traveling.

The steel pulleys guide the winch line around the end of the pipe to be pushed. The end of the winch line attaches to the bottom of the vertical member, which also is attached by a turnbuckle to the truck chassis to hold the truck down.

Taking up on the winch applies a pushing force to the end of the pipe. A powerful engine will push the pipe evenly, without jerking. A winch with more than two speeds will allow pushing at slower speeds for greater accuracy. A short-coupled cab-over-engine truck with an 8-ft bed is used to keep from blocking the street. For easy pushes the equipment can be mounted on either side of the truck or at the rear; in hard dirt truck wheels must be blocked.

Pipe is pushed in 10-ft lengths, with the first length sighted carefully on a target. If the first section of pipe is kept level and straight, the pipe will hit within a 12-in. circle for pushing distances up to 50 ft. Good accuracy also can be obtained for distances up to 100 ft. Lengths up to 200 ft have been pushed with the equipment. Where the greater lengths are pushed, a pick-up coil is used to follow the pipe.

Pipe plugs on the ends of pipes give greater directional accuracy than the conventional pushing plug because the blunt end is not as easily deflected by minor obstructions. For pushing in sand, unplugged pipe and an air tool are used. The shaft of the tool is run through the pipe and a hole is drilled with water pressure behind it, after which the sand is washed out with water. A clamp is used on the pushing end of the pipe, rather than a pulley, to allow insertion of the air tool.

For short distances under sidewalks and driveways, pipe may be pushed directly without using the pushing equipment. The truck is set ahead of the paved areas, the pipe aligned, and the winch line is attached to the far end of the pipe. This end of the pipe must be kept from rising as the pipe is pulled.

Where soil is firm and pulling distances short, the pipe is pulled out and direct-buried cable is pulled through the hole. Under streets and wide sections of paving, pipe is left in place.

(*More Construction on page* 162)

DIELECTRIC TEST EQUIPMENT *by* BIDDLE

...for d-c tests at voltages up to 100 KV

IMPORTANT FEATURES

- Well-designed provisions for utmost safety
- Simple operation and reliable performance
- Excellent output voltage regulation
- Compact, mobile design
- Facilities for voltage and leakage current measurements

IMPORTANT USES

Development—to test d-c dielectric strength of insulating materials and the adequacy of the electric design of insulation in equipment.

Production—for non-destructively detecting defects in electrical insulation.

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NEW TECHNICAL BOOK

A new technical treatise by E. B. Curdts, Director of Engineering, James G. Biddle Co., contains a wealth of pertinent data for the engineer interested in insulation maintenance of electrical equipment.

Copies are available at $2.00 each. Orders should be made on your company's letterhead accompanied by check to the order of the James G. Biddle Co. Ask for Publication 22T1W.

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ELECTRICAL TESTING INSTRUMENTS • SPEED MEASURING INSTRUMENTS
LABORATORY & SCIENTIFIC EQUIPMENT

Bucket Auger Speeds Substation Pier Work

***W. S. REESE**, Engineer, Construction Division, Philadelphia Electric Co, Philadelphia, Pa.*

Crane-mounted rotating bucket auger helped Philadelphia Electric Co bore holes for concrete substation piers. Concrete piers were selected when test boring samples showed cinder, brick and clay fill material at the site.

Although screw-type augers have been used in installing similar piers, selection of bucket augers for this job was based on:

1. Available screw-augering equipment would not reach to required depths of 30 ft.

2. Flexibility of crane mounting provided access to closely-spaced piers. Available screw-augers were truck-mounted and required considerable space adjacent to each pier.

3. Greater capacity of buckets meant faster boring. Ability of the buckets to "capture" excavated material expedited piling and hauling.

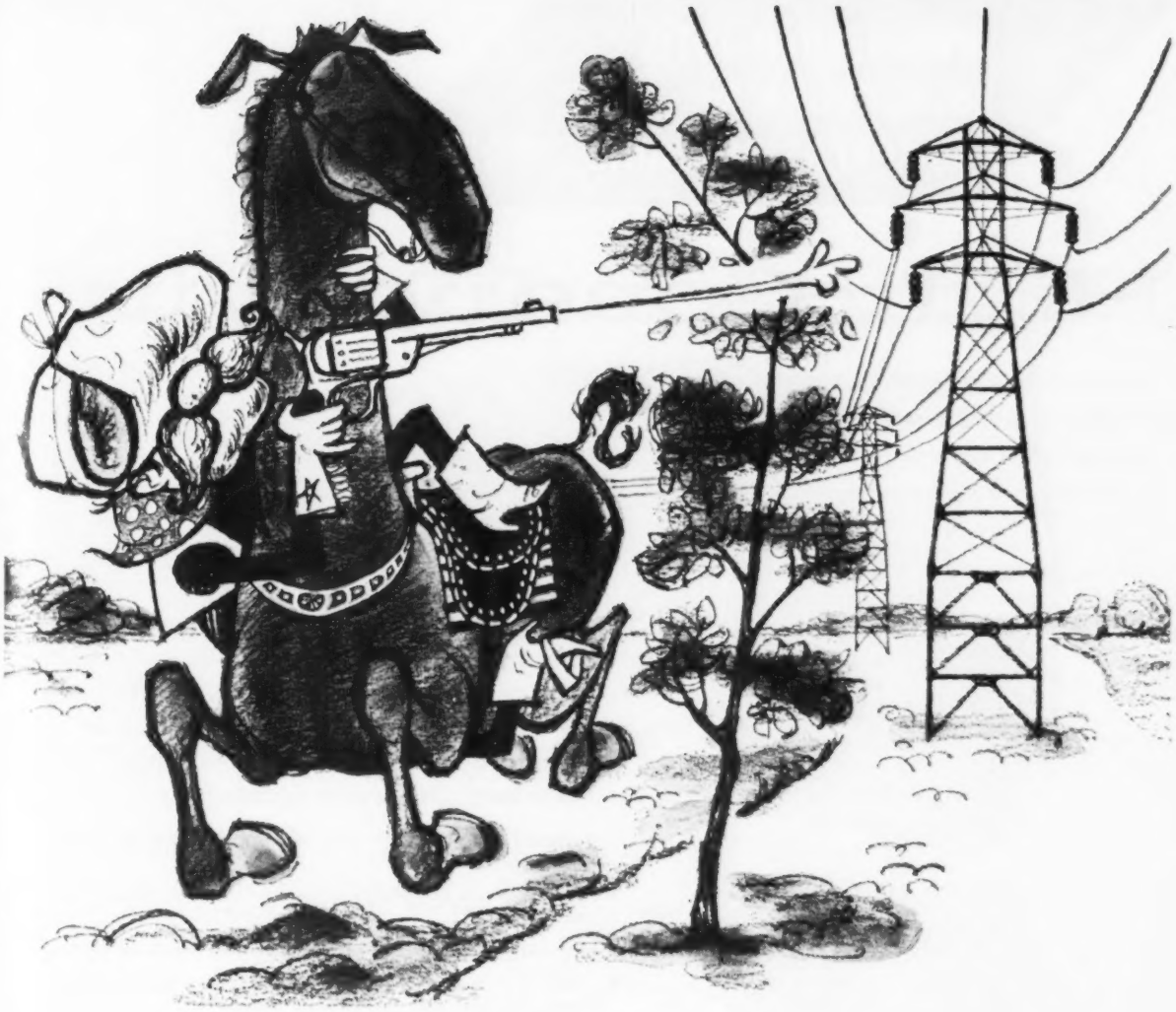
4. Double pulley-wheel arrangement at boom-ends also made cranes available for lifting duties.

A total of 327 3-ft diameter piers was required, varying in depth from 10 to 30 ft. The bucket auger helped install an average of 4 piers per day. The bucket and its shaft or "kelly bar" were suspended by cable from the end of a 50-ft boom; rotating power was supplied by a chain drive extended from the bottom of the crane. Sufficient downward thrust was provided by the weight of the bucket and shaft. The bucket auger was manufactured by Gar Wood Industries, Inc.

Reinforcing steel for the piers was prefabricated in cylindrical baskets and lowered into the holes by the crane upon completion of boring. This permitted concrete to be poured almost immediately, avoiding the necessity of protecting holes from weather or collapse.

CIRCLE 81 ON READER SERVICE CARD

(More Construction on page 166)



Meet the LINE RIDER from the Diamond Spread

THE LINE RIDER AND HIS GANG of Diamond Chemical killers are deadly (for weeds and brush, that is). They're inexpensive killers, too . . . and can save your department thousands of dollars a season.

FOR MIXED BRUSH—LINE RIDER LV-3D/3T, a 2-Ethyl Hexyl Ester formulation of 2,4-D and 2,4,5-T containing 3 pounds each of acid equivalent per gallon.

FOR MAPLES AND OAKS—LINE RIDER LV-6T, a 2-Ethyl Hexyl Ester formulation of 2,4,5-T containing 6 pounds of acid equivalent per gallon.

FOR AREAS ADJACENT TO SENSITIVE CROPS—LINE RIDER AMINE 22, alkyl amine salt formulation of 2,4-D, and 2,4,5-T containing 2 pounds each of acid equivalent per gallon. Applied as a water-borne spray.

FOR SPECIAL CONDITIONS—Also available are other standard LINE RIDER formulations, including Butyl and Low Volatile Esters of 2,4-D and 2,4,5-T containing 4 pounds of acid equivalent per gallon.

If you want deadly marksmanship, send for new LINE RIDER brochure giving details. Write Diamond Alkali Company, 300 Union Commerce Building, Cleveland 14, Ohio.

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CIRCLE 121 ON READER SERVICE CARD

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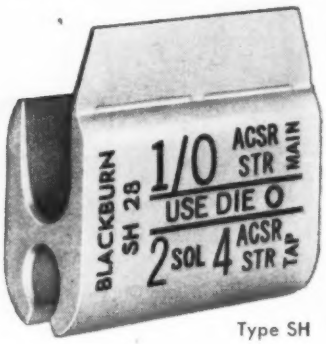
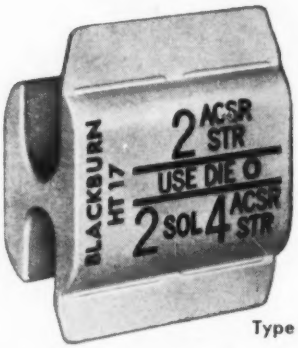
Blackburn has engineered all compression connectors shown to fit your present tooling program—and added advantages to meet engineers' and linemen's requirements.



Type SH

Type HT Prefilled

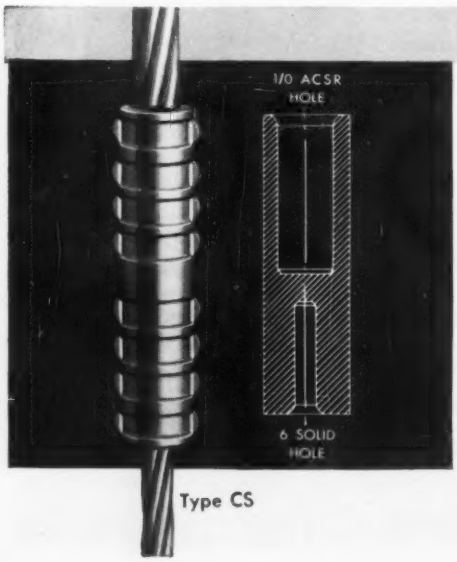
Type SH Prefilled



Type HT

Standardization now possible with Blackburn "H" frame connectors

- Designed to fit the tools you already have for applying "H" frame type connectors.
- Full length tab completely seals out moisture, easiest to bend and install!
- Shot blasted to improve conductivity and retard corrosion.
- Prefilled with Blackburn's superior oxide-inhibiting compound, Contax, in easy-tear tab vacuum package.
- Color fast, large, easy-to-read lettering.
- Type HT is reversible, both grooves "open". For large aluminum tap to smaller copper main. Also used for dead ending.



Type CS

You get higher conductivity with Blackburn service entrance sleeves

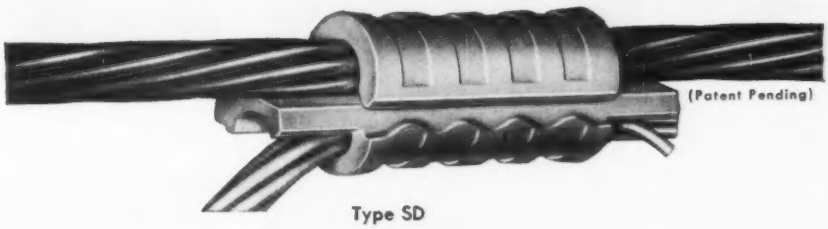
Blackburn—and Blackburn *alone*—provides greater contact area where needed, to assure greater conductivity. This is accomplished by increasing hole depth as the diameter of the conductor is increased, thereby providing more contact area for the conductors being connected.

The Color Coding is *printed* for quick, positive identification.

The sleeves' ends are sealed with Aluminum Sensitized Tape, which is easy to puncture . . . and, if a particle of the seal is pushed into the chamber, the particle is conductive.

Contax, Blackburn's superior oxide-inhibiting compound, is already in these sleeves *in measured amount.* Won't squirt out on glove or in face. And the solid center stop in a Blackburn Sleeve assures proper distribution of the inhibitor around the conductors. Designed for tooling you have.

High "Use-Ability"

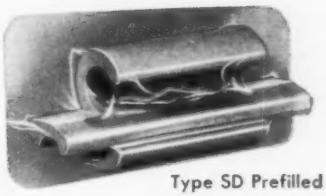


(Patent Pending)

Type SD

Exclusive drip-guard separator in Blackburn 6-frame tap connector gives *extra* protection to bi-metallic connections

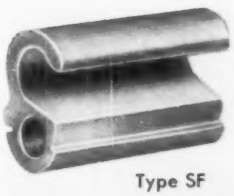
- Spacer allows SD Connector to be used for bi-metal connections with the tools you already have for "C" Frame type connectors.
- An economical substitute for "L" taps, since extended drip guard gives extra insurance against corrosion products bridging the bi-metallic gap.
- A true *two-handed* connector, very adaptable for hot line work.
- Shot blasted for highest conductivity and corrosion resistance.
- Prefilled with Blackburn's Contax and vacuum packed for insurance against corrosion.



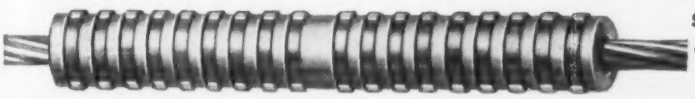
Type SD Prefilled

Type SF

- Recommended for aluminum to aluminum.
- Spacer gives better protection against strand breakage.
- Can be installed with same tooling used for Type SD.
- Prefilled with Blackburn's Contax and vacuum packed for insurance against corrosion.



Type SF



Type TR

Blackburn neutral repair sleeves save dollars on triplex services

- Salvage short lengths of pre-assembled service drop cable with Blackburn Sleeves.
- Designed for and tested with the tools you already have.
- Extra length engineered for neutral pullout values in keeping with dead end devices.

See JB Catalog 858 for Tooling INFORMATION

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CIRCLE 131 ON READER SERVICE CARD

LET'S TALK ABOUT STRAND...

Aluminized STRAND

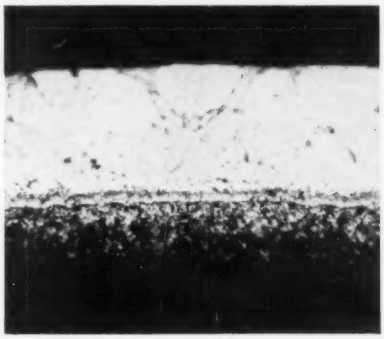
ACCO *Aluminized* steel strand is composed of steel wires which have an adherent, ductile aluminum coating applied by the hot dip method. The result—strand with all the strength of steel, and with the corrosion-resistance of aluminum. Also, you get these important advantages:

Aluminum oxide protection—Aluminum, when exposed to the atmosphere, has a film of aluminum oxide formed over it. This film, though thin, is impervious to corrosive atmospheres, provides extra protection in the most severe service.

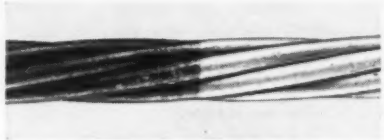
Electrochemical protection—Should nicks or cuts pierce the aluminum coating, the corrosion-resistance will be retained by an electrochemical "healing" process.

Salt spray tests, conducted according to ASTM procedures, show that with equal thicknesses of coating, *aluminized outlasts galvanized by more than 2 to 1.* Available for guy wire, ground wire and messenger wire applications, Page ACCO Aluminized steel strand is offered in Common, Siemens-Martin, High Strength, Extra High Strength and Utility grades with physical properties conforming to ASTM Spec. A-122-54T and A-363-58.

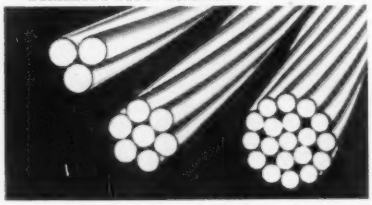
Page also makes galvanized and stainless steel strand.



500X magnification above shows thin aluminum-iron alloy resulting from diffusion of the two metals, and the outer layer of aluminum in the form of a fine-grain cast structure.



5-year test exposure to industrial atmospheres covered strand with coating of sulfide, oxide and soot. Scrubbing with soap and water showed aluminum coating completely unaffected.



Page ACCO Aluminized steel strand is available with 3, 7 and 19-wire construction.

WRITE FOR DETAILS. Booklet DH-537 explains manufacture, properties and uses of Page ACCO Aluminized Steel Strand. Write us at Monessen, Pa., for your copy.

PAGE MANUFACTURERS WIRE

ACCO

Page Steel and Wire Division
American Chain & Cable Company, Inc.
Monessen, Pa., Atlanta, Chicago, Denver, Detroit, Houston, Los Angeles, New York, Philadelphia, Portland, Ore. San Francisco, Bridgeport, Conn.

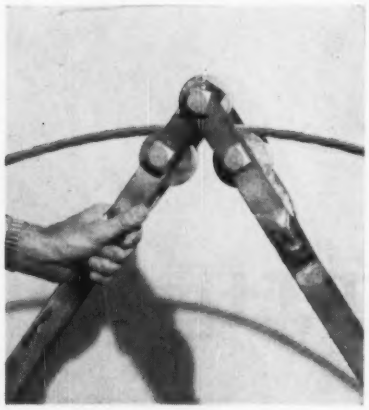
OTHER ACCO ALUMINIZED STEEL WIRES

Aluminized ACSR core wire now available from leading manufacturers of aluminized conductor cable.

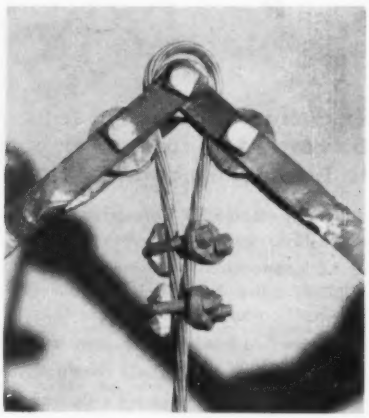
Page Chain Link Fence of ACCO Aluminized wire provides economical, longer-lasting protection.

Tie wire, telephone and telegraph wire, lashing wire, barbed wire, and other products are also available in Page ACCO Aluminized wire. Ask us for details.

PAGE *-the source for answers to wire problems*



GUY STRAND is threaded through the rollers of the folded tool . . .



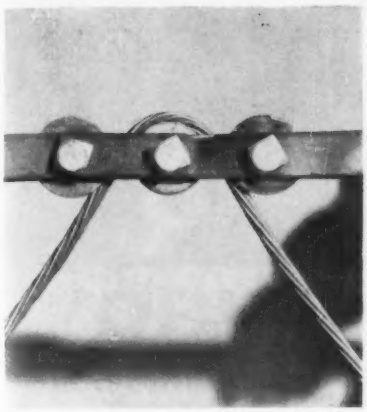
CLAMPS are bolted on while tool holds guy strand in closed position . . .

Tool Makes Up ½-

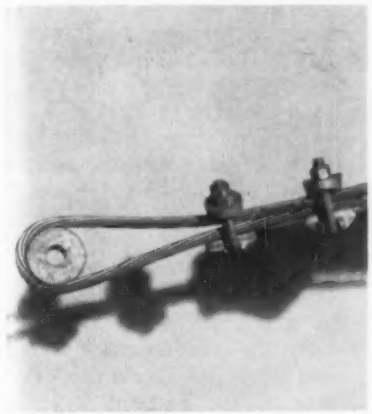
The problem of holding and bending stiff guy wire when making-up ½-in. guys in the field has been solved for construction and operating crews of Kansas Gas & Electric Co by the development of a simple, inexpensive tool. This guy-wire tool not only eliminates an annoying operation but also does the job easier and faster than former methods.

The tool was made in KG&E shops from three rollers, used in making-up guys, and from flat steel straps. The straps are joined together by welding and are drilled to take bolts that will hold the rollers in position.

To make-up guys in the field,



TOOL AND STRAND are turned over and handles are brought together . . .



CENTER ROLLER is removed with guy and may be placed in strain insulator

Up ½-in. Guys

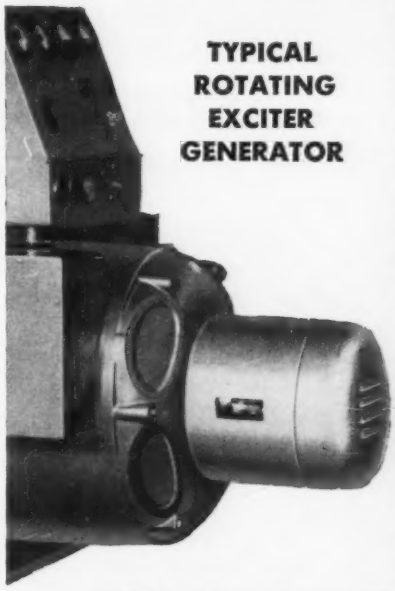
guy wire first is fed through the tool. Then the handles of the tool are pivoted around the center roller. This movement brings the guy wire into position for making-up the guy. The tool also holds the guy wire in position while the guy clamps are tightened.

When the make-up is completed, the bolt holding the center roller is removed and the center roller comes out of the tool with the guy and becomes part of the guy. The roller may be placed into position easily in a wood guy strain insulator.

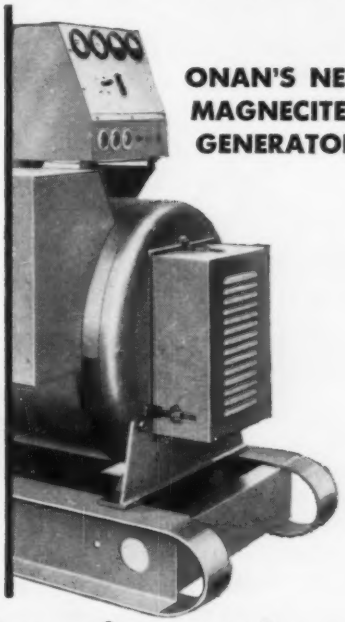
(More Construction on page 168)

THE "NEW LOOK" IN GENERATOR DESIGN

on large Onan gasoline and diesel plants



TYPICAL ROTATING EXCITER GENERATOR



ONAN'S NEW MAGNECITER GENERATOR

Eliminates all moving parts in exciter and voltage regulator

Steps up performance in primary and emergency standby installations

- ✓ ***FASTER VOLTAGE RECOVERY***—Rated voltage is restored within one second after load is applied or removed, compared with 5 seconds for a rotating exciter generator.
- ✓ ***LESS VOLTAGE FLUCTUATION***—Voltage fluctuation with load changes is less than half that of standard-type generators.
- ✓ ***GREATER RELIABILITY***—New design eliminates hundreds of electrical connections, the commutator and its brush rig, and many other "break down" points.
- ✓ ***FEWER ADJUSTMENTS***—No extra sensitive adjustments necessary. Regulator has no delicate multiple contact points.
- ✓ ***EASIER SERVICING***—All exciter and regulator components are easily accessible. No dismantling necessary.

New Magneciter generators are now standard equipment on all Onan Electric Plants of 100, 125, 150, 175 and 200KW, as well as on many smaller sizes. A choice of Diesel or gasoline engine power is available on most Magneciter-equipped models. Complete specifications on any or all Onan units will be sent on request.

Find Us Fast In The Yellow Pages

Onan builds a complete line. Air-cooled gasoline models from 500 to 10,000 watts; air-cooled Diesels in 3 and 5KW; water-cooled gasoline models from 10 to 150 KW; water-cooled Diesels, 10 to 200KW. Also separate generators, D.C. plants, and accessories.

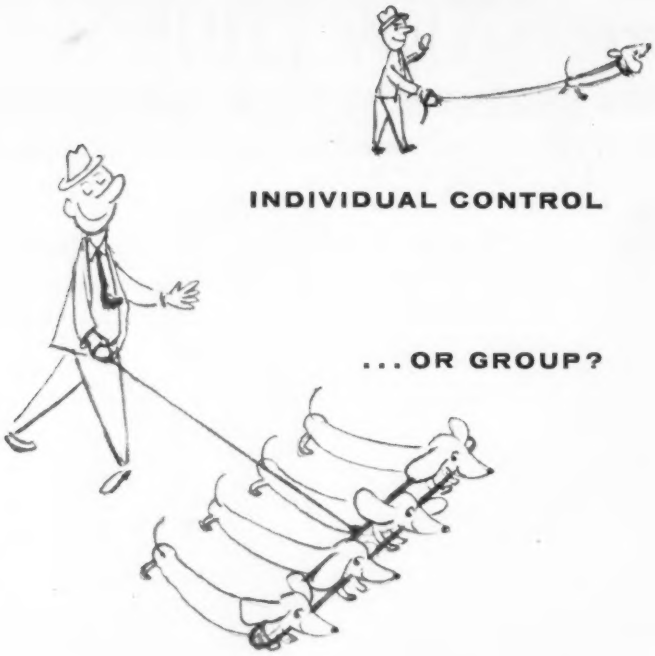
Call the Onan distributor listed in your telephone book or write directly to us.

D. W. ONAN & SONS INC.

2707 University Ave. S.E., Minneapolis 14, Minnesota

Onan ELECTRIC PLANTS

CIRCLE 129 ON READER SERVICE CARD



Whether you should use *one* photoelectric control per lamp in your street-lighting circuits — or *one* control plus an auxiliary relay for a *group* of lights — is up to you. Even though the trend for several years has been toward individual control, there are times when one good photoelectric control plus a dependable auxiliary contactor offers a practical and economical way of switching a group of lights. We make equipment for both methods and here's what we have if you prefer pilot wire control or cascading to the one-control-per-lamp method.

The new 250A Multiple Relay is a dependable, simple and inexpensive relaying device that has only two components — both of them well-proven by considerable field service. One is a 30-amp. load contactor which is the same as the one used in thousands of Fisher-Pierce controls for many years; the other is a reliable, expulsion-type lightning arrestor which protects the contactor. A weather-proof cast aluminum housing measures only about 3" x 3" x 2". The 250A will withstand a 300 ampere max. inrush current, a 2500 volt hi-pot, and has SPST double-break contacts available either normally-open or normally-closed.

What the Type 250A has to offer is greater ruggedness, maintenance-free operation, small size and an extremely low price.

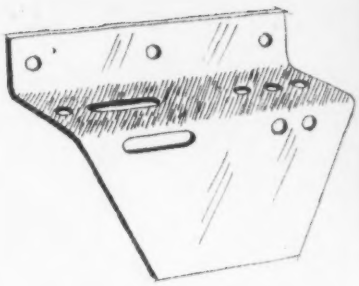
F-P also makes a complete line of photoelectric controls; but that's a subject by itself. The main thing is probably not how many "leashes" you have or how they're connected, but *who* makes the vital links that *control* the whole hook-up. The Fisher-Pierce Co., 82 Pearl Street, South Braintree 85, Massachusetts.

FP

FISHER PIERCE

PHOTOELECTRIC LIGHTING CONTROLS

AN AFFILIATE OF SIGMA INSTRUMENTS, INC.



Mount Pothead on Universal Plate

*J. P. **CLYDE**, Senior Engineer, Commonwealth Edison Co, Maywood, Ill.*

Pothead installations have been simplified and costs have been reduced appreciably by Commonwealth Edison Co through the use of a universal pothead mounting plate. The ¼-in. steel plate is drilled and slotted to accept potheads of all makes and voltages from 4 kv to 34.5 kv. It can be installed either in vaults or on poles.

The plate fastens to poles with standard bolts. The lower bolt, of the double-arming type, secures the lower end of the plate and permits alignment of the bottom of the pothead with the cable.

Straw-Gravel Road Carries Heavy Units

***ROBERT F. TANNER**, Senior Engineer, Indiana & Michigan Electric Co. Fort Wayne, Ind.*

An inexpensive temporary road for heavy equipment in muck or swampy areas can be made from straw and gravel. A 1-ft layer of pit-run sand and gravel is spread over a 1½-2-ft bed of loose straw. The cost is about $125 per 100 ft of 12-ft roadway.

One bale of straw and ½ cu yd of gravel are required for each running foot. After construction is completed, the sand and gravel are used as backfill and the straw is scattered over the land to rot away.

public utility men prefer—

YORK-HOOVER
YMR-76 Service Bodies

MODERN

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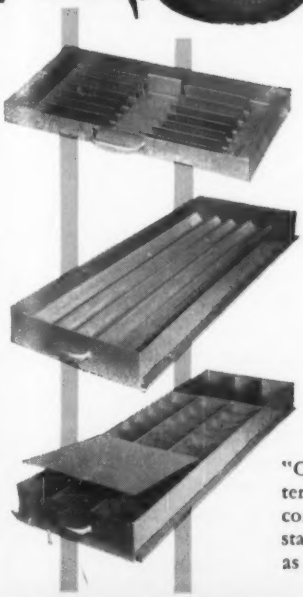
EFFICIENT



LESS SERVICE HOURS...

plus extra savings in operators time are the results obtained by hundreds of YMR-76 Service Bodies in operation today. That's because YMR-76 units are compact and rugged . . . provide ample and convenient carrying space for materials and tools . . . with capacity for adjustment to meet changing conditions. Write for complete details, price and delivery information today!

"Custom" features such as material drawers with adjustable compartments are available as standard or optional equipment, as required.

CLIP AND MAIL TODAY!

Dept. 1E, York-Hoover Corporation
York, Penna.

Please send me a copy of Bulletin No. 942 covering your YMR-76 Service Body.

Name_____

Company_____

Address_____

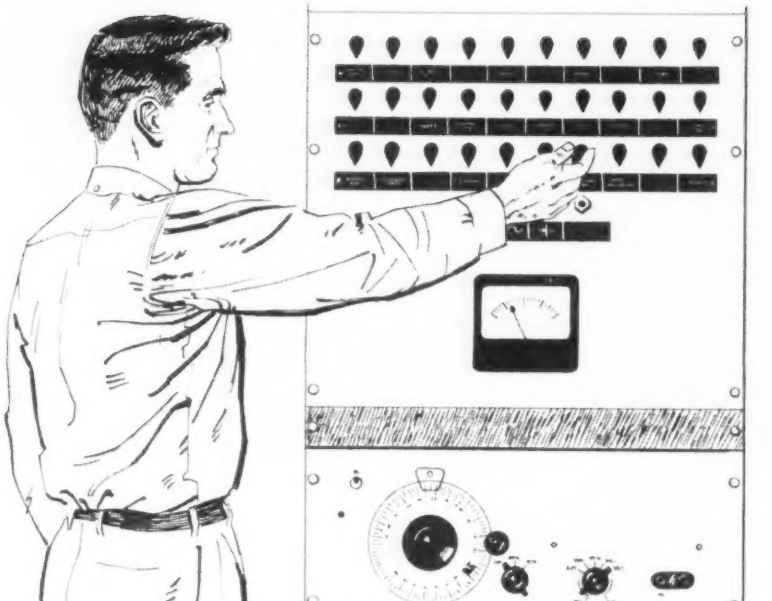
City and State_____

BODY DIVISION
YORK-HOOVER CORPORATION
YORK, PENNSYLVANIA

CREATIVE ENGINEERING FOR THE PUBLIC UTILITY INDUSTRY SINCE 1892

CIRCLE 133 ON READER SERVICE CARD

Locate Faults Quickly in Telemeter Channels



W. A. BALSLEY, *Asst Supervisor, Meter Service, Meter and General Shops, West Penn Power Co, Connellsville, Pa.*

Location of faults in the load-control telemetry system can be determined easily and quickly by the West Penn Power load dispatcher with a test unit called the Go-No-Go. The test facility will pinpoint faults in one of these areas: originating, communications, or receiving. It is designed so that the dispatcher and power station operators, with a few simple tests, can isolate the fault. The test device was developed by West Penn's Meter and General Shops in cooperation with the Communications Dept.

The equipment consists of a switching panel, test oscillator, test impulser and voltmeter. A test can be made on both variable

Rubber-Plastic Spacer

H. A. BITHER, *Working Foreman, Portland General Electric Co, Portland, Ore.*

Plastic-rubber spacer for making service connections to spun secondary, patented by the author, has performed satisfactorily during the five years of exposure in the rough-weather territory served by Portland General Electric Co. The spacer device may be installed by one man in seconds and will accommodate service drops to four residences.

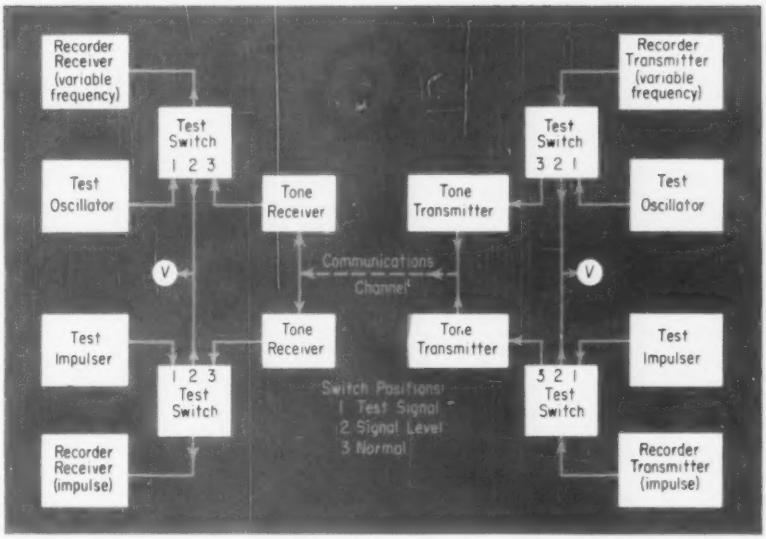
The first spacer was made of treated wood, but a newer model is made of a plastic-rubber material rigid enough to support conductors away from the neutral. To protect the lineman, bare neutral and messenger cables are enclosed at the center of the

PLASTIC-RUBBER SPACER encloses neutral while lineman connects services to phase wire held away from neutral

frequency and impulse telemetry systems. The switching panel has a three-position switch for each telemetry channel, providing a position for (1) applying a test signal, (2) monitoring the telemetry signal level, or (3) a normal by-pass of the test facility. A test panel and associated equipment are at each terminal.

To test a channel, the dispatcher first applies a test signal to the receiving end, thus proving the receiving recorder. He also can measure the incoming telemetry signal level by switching in the voltmeter. If the recorder and signal level prove satisfactory, the dispatcher requests the power station operator to apply a test signal at the transmitting point to test the communications system. A voltmeter at the transmitting point provides a visual checking of the signal level of the originating equipment.

Each voltmeter is calibrated with the scale divided into two sections—red and green, for testing variable frequency systems. A satisfactory signal will be indicated in the green section. For checking impulse telemetry systems, the voltmeter indicates the impulse by swinging up-scale during the impulse time.



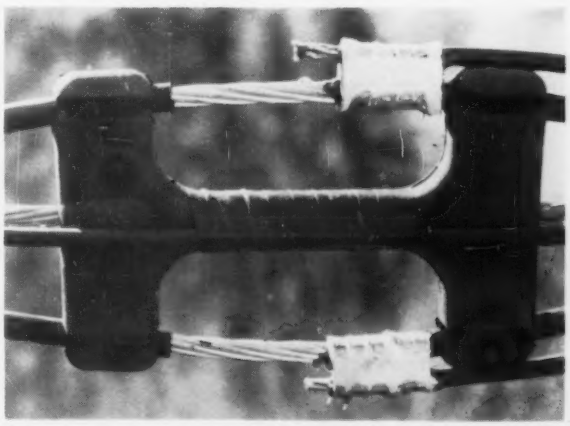
The equipment installed at the Charleroi load dispatching center has proved valuable in maintaining the telemetry equipment. The test facility is being expanded to include all points of telemetry involved in load control.

er Speeds Installation of Services

spacer. Connections are left bare, because they are permanently separated. This saves tape and labor.

The spacer provides maximum safety and minimizes installation time. On a job where the secondary could not be reached from the truck, the ladder was carried to the line, spacer and service installed, and ladder returned to the truck in 17 min. Installation of the spacer itself required but a few seconds. With the energized phrase wires permanently separated, it is an easy matter to install additional services.

Combination for spun secondary in general use at PGE is a ⅜-in. utility-grade messenger, No. 2 all-aluminum bare neutral and 2/0 all-aluminum conductors insulated with 4/64-in. polyethylene. Generally a No. 4 all-aluminum 2/64-in. polyethylene street lighting wire is included in the bundle.



FINISHED CONNECTIONS are left bare as conductors are permanently separated. This reduces labor and saves tape

(More Operation & Testing on page 173)

CIRCLE 135 ON READER SERVICE CARD

new! always RIGHT FOR ANY BI-METAL OR Al TO Al CONNECTION
WEAVER
PARALLEL GROOVE CLAMPS
ni-cad* COATED!
The weatherproof NICAD coating (over a hi-strength aluminum body) keeps any bi-metal connection troublefree, come what may: Heat, cold, salt, alkali, you name it!
They eliminate trouble caused by... (1) Oxidation of Cu against Al; (2) Unequal expansion or contraction of lines and clamps during severe temperature changes. Contacts stay tight—no arcs.
NO SEPARATE INSERTS TO CATCH MOISTURE AND CAUSE CORROSION!
NO SOLDERED JOINTS!
Permanent Low-Resistance Connections
WRITE FOR SAMPLES FOR TESTING
Five sizes now available (NI-CAD coated or non-coated) to cover all requirements.
*Extremely heavy coating of cadmium and other corrosion resistant elements
2110 HOWARD ST. • ST. LOUIS 6, MO. • GArfield 1-6336
J. A. WEAVER Company

Boom Cleans Insulators

Increasing seasonal concentrations of air pollutants and "smog" has prompted California Electric Power Co to acquire a specially-equipped truck, called the "giraffe", for washing transmission, substation and even distribution insulators.

Mounted on an International 6 x 6 truck with three driving axles is a hydraulically-driven boom, a 1,000-gal water tank and a pump. The pump is capable of spraying water at 700 psi from a fog nozzle in the insulated crow's nest atop the articulated boom, which can reach 52½ ft.

The rig is provided with dual controls for the boom and aerial platform as well as outriggers for truck stabilization.

During seasons when rain does the insulator washing for Calectric, the "giraffe" will be used in line repair and construction work.

CIRCLE 82 ON READER SERVICE CARD

Identify Dies In Tool Box

Hot stick dies are selected from the die box more easily with the assistance of a printed identification sheet. The arrangement was developed for crews of San Antonio Public Service Board.

Die identifications are printed on thin sheets of aluminum, which are glued to the inside of the lid of each die box. Identifications are printed on the sheet in positions corresponding to those of the dies in the box, similar to charts in "sampler" candy boxes.

Holes are drilled in the tray of the tool box for the dies. A wooden separator keeps each die in place.

Handles on the ends of the tray do not interfere with inserting or removing dies. The tray can be lifted from the box.

(More Operation & Test on page 174)

Now! ELECTRICAL Fire Fighting with this complete dry chemical line!

Kidde top-rated portables and wheeled units kill more fire... faster!

From the powerful new 2½-pound portable, on up to the giant 200-pound wheeled unit, Kidde dry chemical extinguishers pack the *extra* punch needed for stubborn blazes, for *full-power* fire fighting. Available in pressurized 2½, 5, 10, 20 and 30-pound capacities, Kidde dry chemical portables feature simple, one-two operation, are easiest of all portables to operate, even while wearing gloves. Kidde portables have no valves to turn, no pins to pull, need no bumping or inverting. Just aim, pull trigger, and fire's out! All are quickly and easily pressurized, have dust- and moisture-proof gauges which show at a glance when unit is charged.

The 200-pound Kidde pressurized wheeled unit discharges a 40-foot dry chemical stream faster, has an *extra* 50 pounds of fire-smothering dry chemical to knock down fire quicker. It's faster and easier to operate... just remove pin, swing toggle lever, and flip on-off lever. Easy to maneuver because of its low center of gravity and larger wheels. Truly a one-man fire engine!

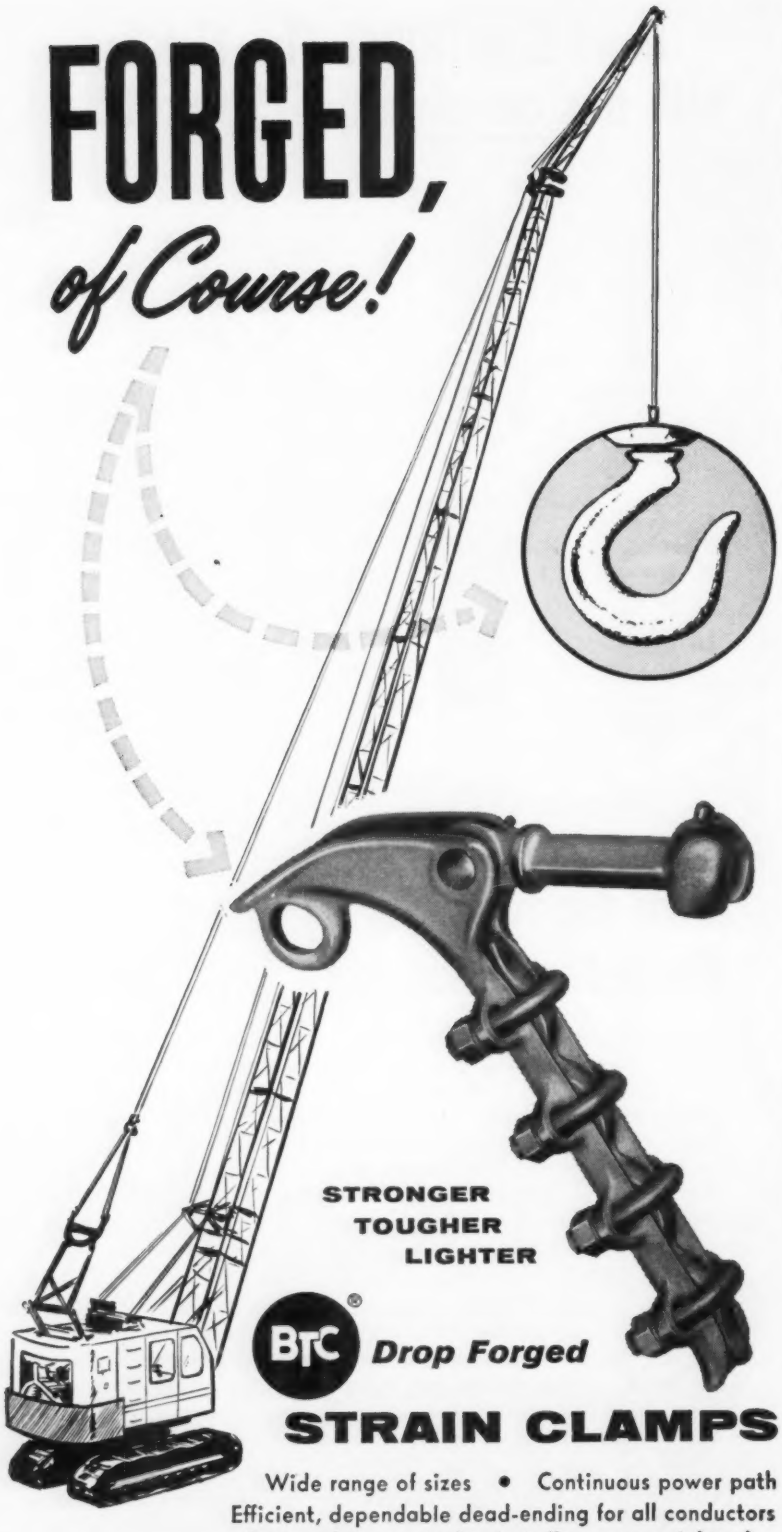
All Kidde extinguishers are granted top rating by Underwriters' Laboratories, are the finest extinguishers on the market today. Get more information about this *complete* line of *full-power* fire fighting equipment. Write to Kidde today!

Kidde

Walter Kidde & Company, Inc.
630 Main St., Belleville 9, N. J.
Walter Kidde & Company of Canada Ltd.
Montreal—Toronto—Vancouver

CIRCLE 137 ON READER SERVICE CARD

FORGED, of Course!



STRONGER
TOUGHER
LIGHTER

BTC® Drop Forged

STRAIN CLAMPS

Wide range of sizes • Continuous power path
Efficient, dependable dead-ending for all conductors
Easy and economical to install — no special tools
Specify the best — BTC Hi-Line Hardware

THE BREWER-TITCHENER CORPORATION
HI-LINE HARDWARE DIVISION • CORTLAND, N.Y.

Slide Rule Finds

R. K. WALKER, Engineer, Overhead Distribution, City of Seattle Dept of Lighting, Seattle, Wash.

Calculation of the number of hours a street lamp has burned between two dates is simplified by a circular slide rule devised by R. J. Ursic, Seattle City Light.

The need arose because City Light, having purchased mercury vapor street lamps with a 9,000-hr guarantee, had to compute the actual hours burned by a lamp before it failed, to get credit from the supplier on the guarantee. But the calculation is tedious because the number of burning hours each day is a function of the season. Therefore, the astronomically-calibrated slide-rule was designed.

All lamps are dated when put

Roller Dolly Carries

ROBERT BARBER, *Superintendent, Line Department, Toledo Edison Co. Toledo, Ohio*

Lamp Burning Hours

in service and when removed after failure. These two dates are set in on the Ursic sliderule, and the number of burning hours—or the credit hours short of 9,000—are read off directly.

167.5-Kva Unit

Distribution transformers up to 167.5 kva are transported on a roller-type dolly through, over and around landscaped areas to rear-lot lines without damage to lawns or driveways. Customer acceptance of this method is reflected in requests from residents that the entire lawn be rolled. Five roller dollies are in use on the Toledo Edison Co system.

Each unit is made of an angle-iron frame, a removable 1¼-in. pipe handle, and two aluminum rollers about 8 in. in diameter. Two rollers allow the dolly carrying a transformer to be skewed around easily. Width of the unit is about 30 in.; weight is 82 lb complete and 66 lb without the handle. A standard at the rear of the platform may be lowered to balance the dolly in an upright position.

(More Operation & Test on page 176)

WHAT HAPPENED HERE?

The price was low, and the controls he bought for the street lighting project met minimum specs.

But*..... Performance? *Unreliable.

Overall cost? *Far above expectations.*

Before *you* decide on *any* automatic light control, remember:

LUMATROL MODEL T IS THE ONLY CONTROL THAT IS TUBELESS...CONDENSER-LESS ...RECTIFIER-LESS...AND STILL HAS RESERVE CONTACT CAPACITY...PLUS SUFFICIENT TIME DELAY TO PROTECT YOUR MERCURY VAPOR LIGHTS!

Patented Lumatrol cover permits light sensitive cell to face up for zenith sensing. No orientation!

Thirty-thousand installations prove 99.5% reliability.

WRITE FOR FULL INFORMATION

MANUFACTURED UNDER PATENTS AND PATENTS PENDING BY

MICRO-BALANCING, INC., HERRICK ROAD, GARDEN CITY PARK, L. I., N.Y. • PI 6-0851

IN CANADA: J. R. KEARNEY CORP. • BOX 270, GUELPH, ONTARIO

A PRODUCT OF STAMPINGS, INC.

THIS TRENCH IS COSTING ONLY 1 CENT PER FOOT

with the

POW-R-SPADE TRENCHER

Unsolicited performance reports from actual users state that POW-R-SPADE narrow trenches cost only 1 cent to 3 cents per foot, *including labor.* (Many report much less than 1 cent per foot.) Digging speed varies from 1½ ft. to 17 ft. per minute depending on soil conditions. POW-R-SPADE is light, rugged, with minimum of maintenance. Shipped *completely* assembled. Neat, fast, professional trenches—3 in. wide to 24 in. deep, or 4 in. wide to 18 in. deep Send coupon today.

One man can transport from job to job.

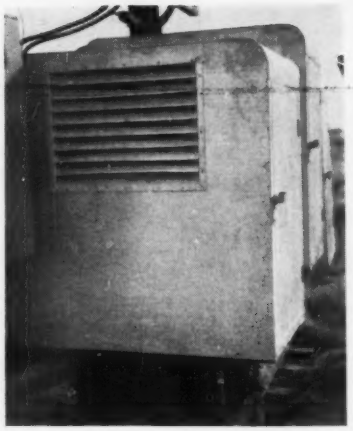
Stampings, Inc., 321-24 St., Rock Island, Illinois
Please send cost and data on POW-R-SPADE:

NAME_____

COMPANY_____

STREET_____

CITY_____ STATE_____



Use Indoor Regulators at Outdoor Site

Sheet metal hoods provide weather proofing for indoor-type 4,160-v feeder voltage regulators adapted to outdoor service on the Kansas Power & Light Co system. The indoor-type regulators became available when an indoor installation was discontinued.

The hoods, equipped with ventilators, were conceived by KP&L's Division Engineer K. E. Bradfield. They were made at a local tin shop.

Auto Brake Slows Cooling Tower Fans

A low-cost braking system for cooling tower fans improves safety and speeds fan braking for Public Service Co of Colorado. A modified automobile brake, adapted for $75, performs as well as an electric braking device costing $250.

The brake is used when it is necessary to reverse the flow of air through the cooling towers. The peripheral speed of the fans is 130 mph. The first brake was used three years ago; five more fans have since been converted.

Previously, the practice had been to turn off the fan and wait until it had slowed to a speed when a 2x4 could be wedged against the shaft. This took 7 min; braking with the new system takes only 2-3 min.

FLINT

Galvanized

STEEL

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• TRANSMISSION LINES

• DISTRIBUTION STATIONS

Is Custom-Made for Your Requirements by

• EXPERIENCED MEN

• MODERN METHODS

STEEL IS AVAILABLE

Competitive Delivery Anywhere
Your inquiries are invited . . .

FLINT STEEL

TULSA, OKLA. MEMPHIS, TENN.

We look inside your commutator at National

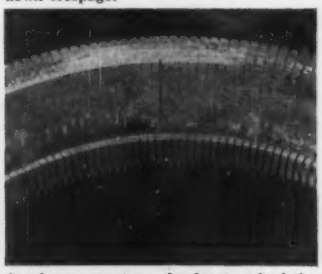
...The Specialists in electric coils/repair service

AND HERE'S WHAT WE OFTEN FIND!

Enlarged view of a dielectric puncture of a mica vee ring at the lower end of the copper bar. This is an example of interior commutator faults which may be present though exterior appears excellent.

Shifted or squirted mica at the apex of the 3° and 30° cone surfaces of a mica vee ring. The black lines on the 3°-surface were made by bar-to-bar voltage breakdown creepage.

The bar which projects above those adjacent has been locally overheated under a brush and softened.



A mica segment on the front end of the commutator has started to work out radially and will eventually result in a bar-to-bar short circuit.

When you send D-C machines to National for rewinding or rebuilding, the commutator gets a close inspection and test. But we've found from experience that a commutator that looks excellent on the surface may be in deep trouble inside... with mica cooked, varnish burned, loose copper, or imminent short circuits.

So when we are suspicious of the commutator we remove and open it for a close interior inspection. It's another added assurance that machines rebuilt by National will give you long, dependable service.

For more information, call National's Columbus plant... HUdson 8-1151. Or call the nearest National field engineer.

National Electric Coil

McGRAW EDISON

DIVISION OF McGRAW-EDISON COMPANY

COLUMBUS 16, OHIO

ELECTRICAL ENGINEERS • MANUFACTURERS OF ELECTRICAL COILS, INSULATION, LIFTING MAGNETS • REDESIGNING AND REPAIRING OF ROTATING ELECTRICAL MACHINES

CIRCLE 141 ON READER SERVICE CARD

Long bow, utility pole or railroad tie—whatever the product—serviceability largely hinges on the method of preservation. Equally critical is the quality of the stock you start with...the raw material. Your wood investment is protected on two counts when you specify AMCRECO pressure treated products. First, a time-tested treating technique, confirmed by major industrial users coast to coast. Second, a 1,500,000-acre timber supply...vast and versatile enough to assure you highest quality grades regardless of your requirements or delivery deadline.

AMERICAN CREOSOTING CORPORATION AMCRECO Louisville 2, Kentucky

Subsidiary of Union Bag-Camp Paper Corporation

Copter Gives High Degree of Brush Kill

S. H. **BROWN**, *Manager, Line Construction and Maintenance*

R. L. **DOLTON**, *System Forester,*
Potomac Edison Co, Hagerstown, Md.

Good results from spraying brush along rights-of-way indicate that a light helicopter provides an important tool for combatting the brush problem. Experience of the Potomac Edison Co covering two growing seasons shows that helicopter spraying in difficult terrain is more economical than spraying with standard equipment. Amount of brush killed-to-ground level along a 132-kv line was 90% of the total; along a 34.5-kv line the brush killed-to-ground level was 72% of total. In addition, helicopter spraying gives a temporary degree of side clearing.

Potomac Edison covers an area of about 8,000 sq miles, containing some very rugged terrain. Mountain ridges rear upward 3,000 ft; the ranges run predominantly north and south while transmission lines run east and west. Such terrain makes application of herbicide most difficult and expensive.

It was decided to use a Bell 57G helicopter to spray one 132-kv line, which varies from 100-150 ft wide and one 34.5-kv line, 50 ft wide. In August, 1957, a spray of 2, 4, 5-T in a non-phytotoxic base oil was applied at the rate of 5 to 5½ gal per acre. All spray material and equipment were supplied by a contractor.

Time required to treat 76 acres on the 132-kv line was 4½ hr; to spray 41 acres on the 34.5-kv line required 1¾ hr. One very difficult area on the 132-kv line had taken 18 days to spray by conventional means while time for the helicopter was 1⅓ hr. Cost per acre was about $42. In the spring of 1958, results of the spray were evaluated, but proved inconclusive.

In August, 1958, a second application covered the same areas sprayed in 1957. In addition, 18 acres were treated using water as a carrier. Results were evaluated on October 29, 1958, covering three random plots each on the 132-kv and 34.5-kv lines. A variety of brush species were found in these plots. Density of brush ranged from 3,600 to 9,800 stems of woody brush per acre. Brush heights were 3½ to 18 ft. Species such as witch hazel, spice bush and dogwood are included in the results because in this growing region witch hazel can grow to 25 ft, while the others may reach 30 to 40 ft.

On the 34.5-kv plots, results were 72% kill-to-ground-level, 16% top-killed-back 3 to 5 ft, and 12% top-killed-back 1 to 3 ft. Total of the 132-kv plots show 90% killed-to-ground-level, 8% killed-back 3 to 5 ft, and 2% top-killed-back 1 to 3 ft. In all plots black locust, sassafras and aspen kill-to-ground-level was 100%. Using helicopter-spraying of rights-of-way, it is believed that five-year brush control could be obtained by skipping a year between first and second applications, and two years following the second application.

In making the applications, these procedures were followed to make helicopter spraying safer and more successful:

1. In flying mountainous terrain, better coverage and results are obtained by spraying from the bottom of the mountain toward the top.
2. Real flying techniques must be used to get coverage on the "uphill" sides of lines with steep slopes at right angles to the line of flight.
3. Air movement not exceeding 5 mph will minimize drift.
4. For maximum effect in the shortest time, spraying must be coordinated to provide possible landing areas, period of least wind, and periods free from ground fogs.

(More Maintenance on page 181)

NAUGATUCK PARACRIL OZO

THE OIL-RESISTANT, OZONE-RESISTANT NITRILE RUBBER

Now—the finest weather-resistant wire jackets can be Colored!

FOR SALES APPEAL • FOR SERVICE EASE

New Paracril OZO—a superior rubber compound developed by Naugatuck—makes possible *new eye appeal, new ease of identification.* And it outperforms standard wire jacket compounds many other ways, too!

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- significantly superior ozone resistance
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- *permanent retention of bright colors!*

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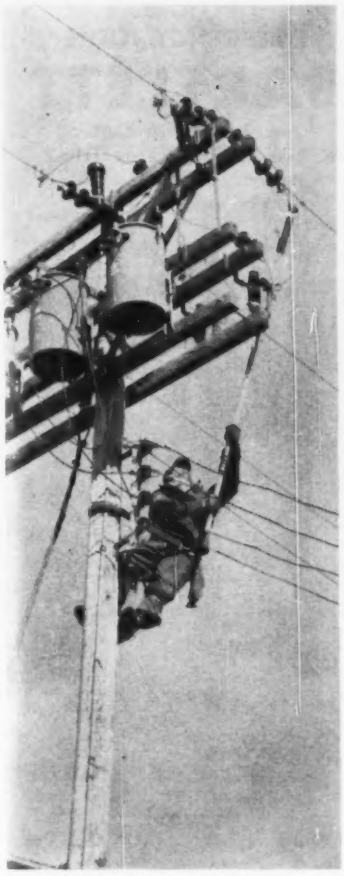


Patrols Check Hot Line Clamps

Primary burn downs resulting from loosening of hot line clamps have been appreciably reduced through regular patrols of Kansas Gas & Electric Co's main primary distribution circuits. The main portion of each circuit is patrolled once every three years.

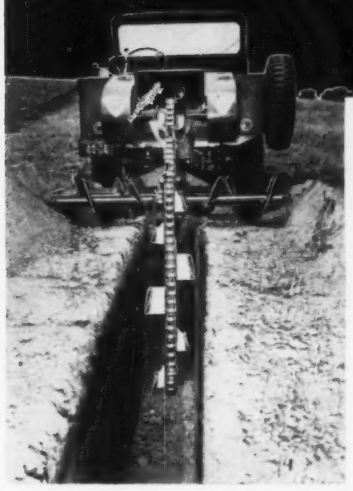
Patrols are made by a three-man crew. Every hot line clamp is tested with a Grip-All hot stick to see if it can be tightened. A visual inspection is made. If there is evidence of trouble, steps are taken to correct it.

Enough clamps have been found either in bad condition or loosened from vibration to justify the preventive maintenance. The number of faults has been significantly reduced and service to customers has been improved.

CIRCLE 83 ON READER SERVICE CARD

(More Maintenance on page 182)

LET AUBURN TRENCHERS CUT your TRENCHING COSTS!



If you want your trenching done at less cost, and with less trouble, you want **Auburn.** This simple, time- and customer-proven machine digs where other trenchers won't even start. It has a variable speed, hydraulic drive that automatically adjusts speed to changing soil conditions, and it operates up to 800 feet per hour. **Auburn** costs less to own, requires less maintenance, seldom has any downtime, and is one-man operated. It has interchangeable digging bits and boom that let you dig from 6 to 14 inches wide, down to 6 feet deep. Special digging bits are available for rock, shale, and frozen ground.

WE TRENCH THE EARTH

Auburn is the world's largest producers of trenchers.

AUBURN GEAR-DRAULIC

Tractor-mounted trenchers are available for M-F Work Bulls, IH Utility, John Deere Crawler and Wheel Industrial, and Ford Tractors.

Jeep-A-Trench GEAR-DRAULIC

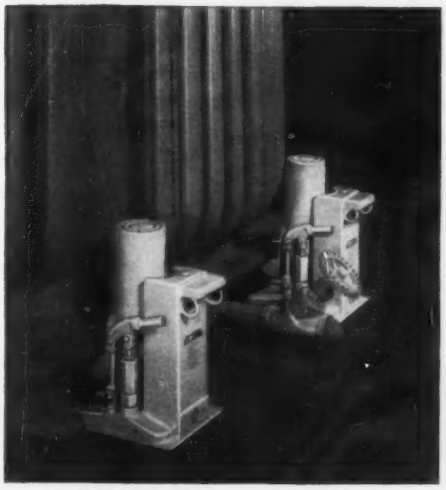
the original Jeep-mounted trencher, and only trencher approved by Willys Motors. Available at Jeep Dealers.

WRITE FOR COMPLETE INFORMATION and Dealer's Name 2040 South "J" Street

AUBURN MACHINE WORKS, INC. AUBURN, NEBRASKA, U.S.A.

CIRCLE 171 ON READER SERVICE CARD

Unique Transformer Jack Lifts Full Capacity on Toe or Cap



Exclusive design accounts for the success of this series of jacks. The roller bearing in the toe transmits eccentric toe loading to the flat milled surface on the stationary ram. This completely eliminates scoring action which is inherent in conventional toe lift hydraulic jacks. Lifts full capacity on both the toe or the cap.

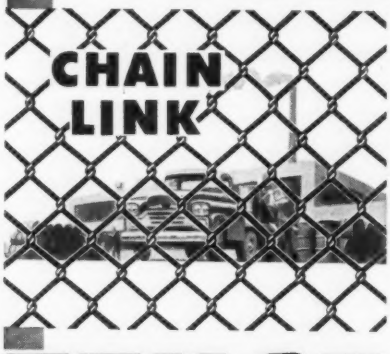
Double pumps provide both speed and power. A safety by-pass prevents overloading. Ideal for lifting heavy machinery and transformers with minimum jacking clearances. Can also be used horizontally. Write for catalog.

Jack No.	Capacity Tons	Weight Lb.	Closed Height Inches	Travel Inches	Toe	Base: Forked Design
TJ-10	10	54	11¾	6	Min. Ht. 1¾" Width 3"	9½"x8"
TJ-25	25	110	14	7	Min. Ht. 2½" Width 4½"	9"x12"
TJ-50	50	230	18	10	Min. Ht. 3½" Width 5½"	11½"x14¼"

TEMPLETON, KENLY & CO., 2515 Gardner Road, Broadview, Illinois

CIRCLE 145 ON READER SERVICE CARD

PAGE



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Fence value depends on
—quality materials
—quality installation
You get both from PAGE

New Aluminized Fabric!
(other quality fabrics available:
galvanized steel,
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8 basic fence designs
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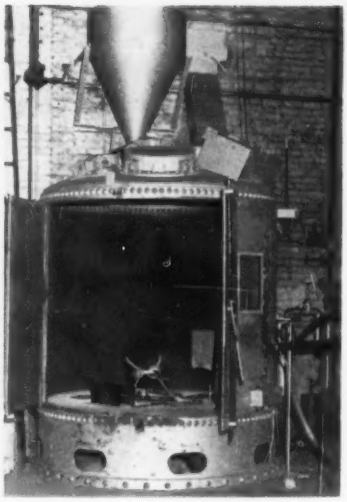

Shot-Blaster Handles Smaller Items

R. W. STORRICK, Supervisor, Electrical Maintenance & Shops Division, Duquesne Light Co, Pittsburgh, Pa.

Shot-blasting of distribution and subway transformer tanks and miscellaneous small items is done simply, safely and economically in a shot-blast cabinet designed and built by general shop personnel of Duquesne Light Co. The unit handles items too small to warant use of the large shot-blast room. Shot-blasting in the cabinet is handled by one operator who handles the work from outside the tank.

The cabinet was built from an old 138-kv breaker tank fitted with double doors, a 6-ft diameter turntable, lighting, an observation window and a row of access ports to admit the hose and nozzle. The turntable supports the work being blasted and acts as a scraper to return the spent shot to a tank in a pit beneath the cabinet. Thus, the need for scraping down the shot to reload the tank has been eliminated; the operator simply moves a lever and the tank is refilled with shot for the next job.

A 1-hp motor through a gear reducer rotates the turntable at ½ rpm. Dust-laden air is exhausted from the cabinet through a cyclone dust collector. The cabinet is lined with rubber sheets to reduce wear on the walls.

(More Maintenance on page 184)

TWO GREAT
EMERGENCY TOOLS

BARTLETT

No. 1-BC Wire Cutter
No. 1-WJ Jointed Tree Trimmer

No. 1-BC readily cuts 110 and 220 RC wire and can be used safely for cutting hot 4800 volt primary and service wire when hanging near ground. Has 12" Bakelite insulator. Two 6 ft. pole sections make operation from ground easy.
No. 1-WJ Tree Trimmer will sever 1¼" branches. Pulley action gives added cutting power. Pole in 4' sections for ease of transportation in small car. No.1-W made with long poles. 6-8-10-12-14 or 16' ft

Write for Catalog No. 39 showing complete line of trimming tools.

BARTLETT MFG. CO.
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SHAW-PERKINS
COOLING
RADIATORS

. . . properly designed to cool power and distribution transformers

Designed and built by the pioneers and specialists in economical, dependable self-cooling methods. Sizes and models for any make transformer. Valves, flanges, elbows available. Transformer tanks built to customer's design.

Write for full information. SP-11

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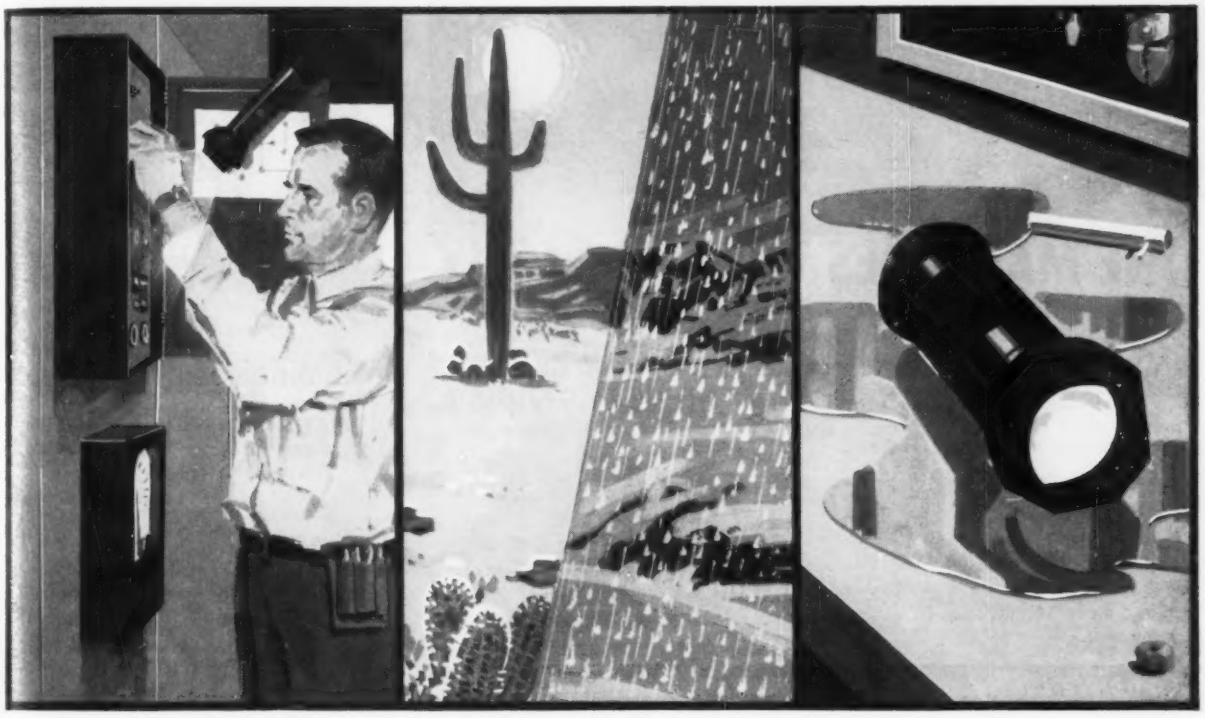
CIRCLE 173 ON READER SERVICE CARD

"EVEREADY" "CORDAHIDE" SHOP LITE WITH MAGNET SWITCH ...HOLDS FAST TO STEEL!



HANDY AS A THIRD HAND...comes with powerful magnet switch! Holds fast to any steel surface . leaves hands free!

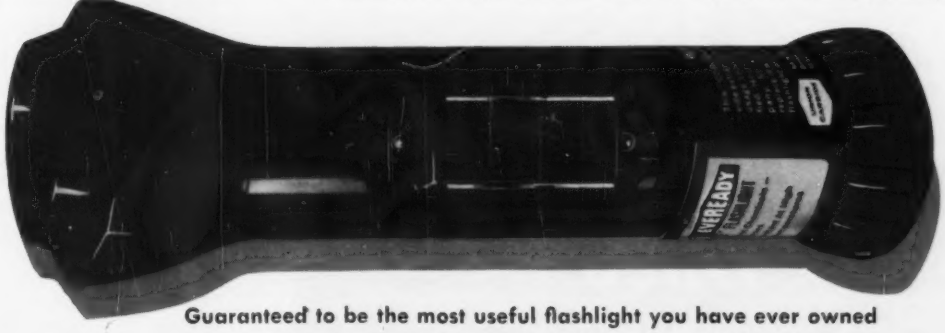
RUGGED AS A ROCK... withstands high and low temperatures, resists shock, takes a beating and comes back for more.

TOUGH AS THEY COME... the new "Cordahide" covering insulates against electricity . . . resists alkali, acid, grease, and oil!

New "Eveready" Shop Lites come in a choice of color combinations... red, green or yellow. Also available with a standard jumbo switch (Model #314) at a lower price.

GUARANTEED

This "CORDAHIDE" Shop Lite will provide extraordinary service under normal usage conditions. If you are not satisfied, return it to National Carbon Company, St. Albans, Vermont. We will replace it with a standard "EVEREADY" flashlight of comparable value.



No. 316

Guaranteed to be the most useful flashlight you have ever owned

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Cable laying in the back yard of the Titan at Martin Denver is easy with a Truco cable reel carrier. Hydraulics make it so simple — so fast — so dependable every time with no accident hazards. You buy safety and buy a bonus of time when you buy Truco.

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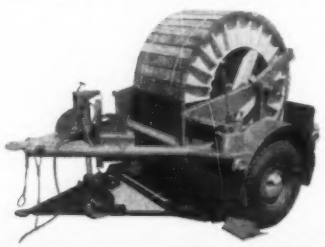
WITH A **Truco** CABLE REEL CARRIER



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Truco TRUCK Equipment COMPANY

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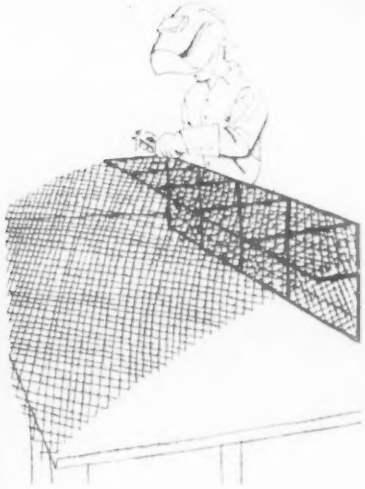
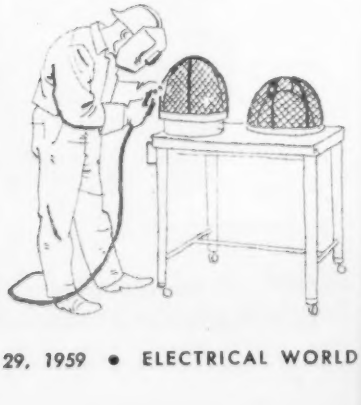


Metal Guards Protect Luminaires

***CHARLES KELLER**, Superintendent, Underground Dept, Toledo Edison Co, Toledo, Ohio*

Expanded-metal guards protect fluorescent and incandescent street light fixtures on the Toledo Edison system without interfering with the light output. Use of guards in certain locations was made necessary by the growing incidence of fixtures being damaged by missiles, particularly in underpasses on major roadways. Since installation of guards on 18 fixtures, further damage has been prevented.

Guards are made by welding pre-cut sections of expanded metal on forms that approximate the external shape of the luminaire. They are attached to the fixtures using mounting brackets. Cost of the guards ranges from $18 for fluorescent units to $12 for globular types.



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BREAKERS & SWITCHES

LOAD BREAK OIL SWITCHES . . . Line of 11 standard types and capacities, with drawings, dimensions and prices. Catalog. ESCO Mfg Co, Box 1039, Greenville, Tex. (41)

FUSIBLE SERVICE EQUIPMENT . . . Type SF with 10 enclosures and five Stab-in units to meet requirements to 200 amp. Technical data, wiring diagrams and information on interchangeable hubs, adapter frames, and other accessories. Bul. 1-215, 12 pages. Federal Pacific Electric Co, 50 Paris St, Newark 1, N. J. (42)

SINGLE-TANK BREAKERS . . . for subtransmission application with ratings through 46 kv. Principles of operation, rating and dimension tables, and drawings comparing internal spacings with three-tank units. Bul. GEA-6881, 8 pages. General Electric Co, Schenectady 5, N. Y. (43)

SECONDARY ARRESTERS . . . Type S3 rated 0 to 650 v; Type L rated 0 to 175 v; and primary protective gaps rated 6, 11, and 15 kv rms. Operating and design features, plus descriptions, application data and ordering information. Bul. LA6, 8 pages. Line Material Industries, McGraw-Edison Co, Milwaukee 1, Wisc. (44)

CRANES & VEHICLES

AERIAL LIFT . . . Model L-40 with insulated Spiralloy insert in pylon mast. Standard specifications, optional equipment, and general information. Booklet, 14 pages. Asplundh Chipper Co, 501 York Rd, Jenkintown, Pa. (45)

HEAVY-DUTY VEHICLES . . . solve specific problems for electric utilities. Illustrations of vehicles and facilities, and examples of unusual equipment for various industries. Booklet, 8 pages. FWD Corp, Clintonville, Wisc. (46)

NARROW-AISLE EQUIPMENT . . . 24-v Master Line units for a variety of materials handling problems. Special powered equipment and heavy-duty two-wheel hand truck for warehouses and terminals. "Lever", March 1959, 16 pages. Lewis-Shepard Products, Inc, Dept R9-5, 125 Walnut St, Watertown, Mass. (47)

CRANE-EXCAVATORS . . . Series 350 Bantam includes 11-ton carrier-mounted Model T-350; 11-ton self-propelled Model CR-350; and crawler-mounted Model C-350. Specifications on basic unit and attachments and all mountings. Bul. 350-1, 8 pages. Schield Bantam Co, Waverly, Iowa. (48)

CONTROLS

MOTOR CONTROL . . . 0 to 40 low-voltage control line for standard and special uses. Design features of basic starter, description of components, and field modification kits. Also, contactor types available and accessory devices. Bul. 14-B9182, 6 pages. Allis-Chalmers Mfg Co, Industries Group, Milwaukee 1, Wisc. (49)

COMBUSTION CONTROL . . . for both chain-grate and spreader stokers. Diagrammatics of typical systems, with discussion of steam pressure and steam flow-air flow measurement. Bul. 515, 4 pages. Bailey Meter Co, 1050 Ivanhoe Rd, Cleveland 10, Ohio. (50)

MOLDED - CASE BREAKER CONTROL . . . Telemand motor-driven electrically operated mechanism for ET breakers in ratings from 70 to 800 amp on switchboards, control centers, or in individual enclosures. Drawings show dimensions; wiring diagram furnishes electrical connection details and control options. Bul. 5047-1A, 4 pages. ITE Circuit Breaker Co, 1900 Hamilton St, Philadelphia 30, Pa. (51)

BTU METER . . . Model 913, plus Model 771 universal recorder and Model 245 flow transmitter, with information and system schematic. Specification sheets. Hays Corp, Michigan City, Ind. (52)

HIGH-VOLTAGE STARTERS . . . for squirrel-cage, wound-rotor, and synchronous motors, air-break and oil-break forms, on 2,200 to 4,800-v systems. Enclosure types are described. Bul. 8130, 8 pages. Square D Co, Electric Controller & Mfg Div, 4500 Lee Rd, Cleveland 28, Ohio. (53)

INSTRUMENTS

DIELECTRIC TEST SET . . . Bench and portable models for step voltage-current (or resistance) tests, withstand and breakdown tests on equipment insulation with ratings in 300, 600, and 2,500-v classes. Design, operating features, specifications and prices. Bul. 22-5, 4 pages. James G. Biddle Co, 1316 Arch St, Philadelphia 7, Pa. (54)

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INSULATION

FLUOROCARBON RESINS . . . Teflon insulation for electrical and electronic systems. Properties, de-

(*Continued on page* 186)

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NEW AIR GAP LINE GUARDS

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BODENDIECK TOOL CO.

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Fluorocarbon Resins

(*Continued from page* 185)

sign considerations, and specific applications, with graphs and tables. Handbook, 26 pages. E. I. du Pont de Nemours & Co, Polychemicals Dept, Wilmington 98, Del. **(57)**

INSULATING MATERIALS . . . including mica mat, varnished cloth and paper, varnishes, irradiated polyethylene, sealing and filling compounds, finishes and adhesives. Technical data plus characteristics and application range in text, tables, and illustrations. Bul. GET-2929, 12 pages. General Electric Co, Schenectady, 5, N. Y. **(58)**

ELECTRICAL INSULATIONS . . . for repair and maintenance of motors, generators, and other equipment. Newer items are red synthetic insulator (spray cans), thermosetting glass banding tape, light-treated glass sleeving, and crimped insulation coils, plus conventional materials and Class-H materials. Ordering data cover sizes, colors, and grades. Cat. 30, 36 pages. Insulation Mfgs Corp, Publication Dept, 565 W. Washington Blvd, Chicago 6, Ill. **(59)**

FLAME-RETARDANT POLYETHYLENE . . . Jacket insulation for wire and cable. Tables and charts, bibliography, and appendix giving specifications. Bul. RCT 710, 12 pages. Rome Cable Corp, Rome, N. Y. **(60)**

BUTYL RUBBER . . . for insulating and jacketing wire and cable. Physical, electrical and chemical properties compared with other elastomers. Listed are manufacturers offering butyl wire and cable, with trade names. Booklet. Thiokol Chemical Corp, 780 N. Clinton Ave, Trenton 7, N. J. **(61)**

INSULATION . . . for rewound motors. Industry uses for which solventless epoxy encapsulation is suited, with physical and chemical properties. Booklet B-7622, 8 pages. Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa. **(62)**

SAFETY

SAFETY HATS . . . Shockgard hats and caps with fixed-crown suspension for safe clearance. Hats meet standard breakdown test of 20 kv. Bul. 0607-3. Mine Safety Appliances Co, 201 N. Braddock Ave, Pittsburgh 8, Pa. **(63)**

PORTABLE RESUSCITATORS . . . Back-Pack model leaves rescuer's hands free to aid victim; Monaghan intermittent positive pressure breathing unit; and oxygen piping system for first-aid areas. Inhalation therapy techniques described. Booklet NM-116, 12 pages. Chemetron Corp, National Cylinder Gas Div, 840 N. Michigan Ave, Chicago 11, Ill. **(64)**

RUBBER-GOODS APPLICATOR . . . for Ubangi line of corona-resistant protective devices permits one-man application. Rubber goods also described. Booklet, 4 pages. W. H. Salisbury & Co, Morgan at Kinzie St, Chicago 22, Ill. **(65)**

STANDARDS & TOWERS

STEEL TOWER . . . Specifications and details of light-weight tower for single-circuit 138-kv line. Folder. Anchor Metals, Inc, Hurst, Tex. **(66)**

LIGHTING STANDARDS . . . Steel or aluminum standards for street, highway or floodlighting. Brackets and arms, modifications, and accessories, and tests and chart data. Catalog, 68 pages. Kerrigan Iron Works, Inc, Box 479, Nashville 2, Tenn. **(67)**

METAL POLE and BRACKET . . . Servisafe units for outdoor lighting. Disconnecting and lowering mechanism for one-man replacement at ground level. Typical installations for shopping centers, parking lots, and industrial locations. Brochure PWB-59, Thompson Electric Co, Box 873-Z, Cleveland 22, Ohio. **(68)**

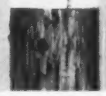
TIMBER POLE GUIDE . . . for pressure-treated poles for highway and street lighting. Application and specification data. Booklet, 8 pages. Western Wood Preserving Operators' Assn, 1410 SW Morrison St, Portland 5, Ore. **(69)**

SYMBOLS & TABLES

METER SYMBOLS . . . for one-line metering diagrams, circuit-wiring diagrams, and meter computations. Outline and sample drawings. Pub. 59-71, 15 pages. Price 60¢. Assn of Edison Illuminating Co's, 40 W. 40th St, New York, N. Y., or Edison Electric Institute, 750 3rd Ave, New York, N. Y. **(70)**

(More Literature on page 188)

New, low-cost way to give old standing poles



GROUND-LINE PROTECTION

Pol-Nu treatment extends the Pole Safety Factor

Pole Safety Factor can be measured in terms of preservative in the wood in the critical ground-line area. Treated poles, as offered by the wood preserving industry, have maximum initial protection against decay and insect damage. However, there is a natural depletion of the protective chemical at the ground-line and this will eventually cause failure if preservative losses are not replaced.

A planned pole inspection program and ground-line treatment with Chapman Pol-Nu protects your line investment. Pol-Nu is a superior grease-type preservative containing a full 10% PENTA-chlorophenol. With the exclusive Pol-Nu Bandage-Maker it is easily applied to standing poles to restore the reservoir of preservative, adding up to 15 years of pole life. The modest application cost is chargeable to maintenance dollars, not the more expensive capital dollars required for pole replacement. Get complete information now, from Chapman Chemical Company.

Portable Pol-Nu Bandage-Maker produces pole bandages of exact size instantly on the job. Pol-Nu preservative feeds onto paper in a uniform, accurate coating.

Bandage is wrapped around previously cleaned pole, may be applied immediately without waiting for wood to dry. Pol-Nu penetrates wood to give lasting protection.

write for complete information

CHAPMAN®

POL-NU

and Pol-Nu Bandage-Maker

CHAPMAN CHEMICAL COMPANY

Leading manufacturer of wood preservatives

P. O. Box 138-B, Memphis 1, Tenn.

PALO ALTO, CAL. • PORTLAND, ORE. • MINNEAPOLIS • CHARLOTTE, N. C.

TABLES and FORMULAS . . . Electrical data, properties of materials, heat transfer and steam information, and measurements covered by tables, formulas, and graphical symbols. Booklet B-3677D, 120 pages. Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa. **(71)**

TRANSFORMERS

PHASE-ISOLATED LTC TRANSFORMERS . . . Three-phase units with individually controlled voltage regulation for each phase. Design and construction details, plus application data. Cat. 591, 20 pages. Pennsylvania Transformer Div, McGraw Edison, Canonsburg, Pa. **(72)**

TRANSFORMER BRACKETS . . . for cluster mounting of three units up to 167 kva. Specifications and selection guide for brackets and adapters. Bulletin, 4 pages. Oliver Electrical Mfg Co, Battle Creek, Mich. **(73)**

PVC INSULATED LEADS . . . for oil-filled transformers. Insulation properties required compared with properties of PVC compound Synthinol 901. Bul. RCT 320, 8 pages. Rome Cable, Rome, N. Y. **(74)**

WIRE & CABLES

CONTROL CABLE . . . with polyethylene insulation and double Densheath (PVC) jackets. Electrical characteristics, and chemical, mechanical and thermal properties, plus conductor identification. Bul. DM 5844, 6 pages. Anaconda Wire & Cable Co, Dept EFL, 25 Broadway, New York 4, N. Y. **(75)**

THERMOWELD PROCESS . . . for welding electrical connections to copper and steel. Method outlined and illustrated. Booklet, 4 pages. Burndy Corp, Norwalk, Conn. **(76)**

VOLTAGE DROP . . . determinations for aluminum or copper conductors based on 22 simplified tables reading in volts. Graphs cover nominal voltages not indicated in tables. Booklet, 33 pages. Kaiser Aluminum & Chemical Sales, Inc, Dept NR-33, 919 N. Michigan Ave, Chicago 11, Ill. **(77)**

ARMOR-GRIP SUSPENSION . . . application guide for field use, with illustrated step-by-step instructions. Booklet 40-300, 12 pages. Preformed Line Products Co, 5349 St. Clair Ave, Cleveland 3, Ohio. **(78)**

For faster, better tree trimming with less fatigue

Chance *Power* Pruners

These air-powered pruners make a clean one-stroke slice through green branches up to 2 inches in diameter. No splitting or chewing of branches. Jaws re-open automatically after each cut. These lightweight, well balanced tools are easy to use—require no experience to operate from "buckets," ladders, or in trees.

Chance power pruners, guy strand cutters and cutters for electrical conductor are air powered. They operate from many power sources — compressors of any type or standard cylinders of dry nitrogen. Insulated and non-insulated models are available.

A. B. CHANCE COMPANY

CENTRALIA, MISSOURI

A.B. Chance Co. of Canada, Ltd., Toronto

CT59-14A

CIRCLE 152 ON READER SERVICE CARD

NEW!

MULTIBAR SEAL

Trademark

PUT IT ON WITH ONE HAND!

Designed for speedy operation. No tools needed to apply or remove. Seal is self-destroying if tampered with.

Fits all watthour demand meter resets

(Shows application of wide bar)

(Shows application of both bars)

— and time switches

(Shows application of narrow bar)

Use exactly as is or break away proper bar; insert seal and bend the end portion.

Made of aluminum and *always* furnished with company initials and consecutive numbering.

Write for samples and prices.

Brooks PROTECTING INDUSTRY SINCE 1873

E. J. BROOKS COMPANY

198 North 13th St. • Newark 7, N. J.

CIRCLE 175 ON READER SERVICE CARD

AIRWAY-TO-MOUTH technique of reviving a victim insures an air passage and increases tidal volume of air exchange

Utility Adopts "Breath of Life" Resuscitation

H. G. TRIPP, Safety Director, Electric Power Board of Chattanooga, Chattanooga, Tenn.

New technique based on mouth-to-mouth rescue breathing has been adopted by Electric Power Board of Chattanooga as the primary means of resuscitating victims who have stopped breathing. Field forces of the Board are being trained in the direct mouth-to-mouth method and in the mouth-to-airway method using two types of airways.

Plastic S-shaped airways (breathing tubes) are carried on all vehicles of the Board and have been placed at strategic locations on the system. This plastic airway, available from Johnson & Johnson Co for about $1.50, is designed with an integral mask making it adaptable to adults and children three years or older. For younger children, the airway may be reversed and the smaller end of the tube placed in the victim's mouth.

The Board also has equipped some line trucks with a second type of device (Globe mask-to-mouth resuscitator) consisting of an airway attached to a flexible breathing tube about 2 ft long. A diaphram in the middle of the device allows the rescuer to introduce air into victim's lungs but directs the victim's exhalation out through a porthole on the side of the tube. This device is part of a kit including a carrying bag and an aspirator for removing mucus or vomitus from the victim's throat.

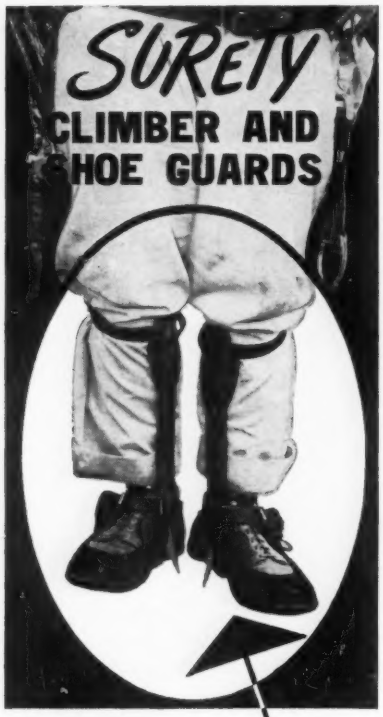
Secondary rescue equipment used by the Board includes a portable inhalator, with a 20-min supply of oxygen, carried in all safety cars, and a full-cycle oxygen resuscitator operated by a 12-man trained crew.

Following adoption of the new technique, employees of the Board were briefed by the Safety Dept in the effectiveness of mouth-to-mouth resuscitation through demonstrations and a color movie made at Walter Reed Hospital. The chief advantage of the new method is that it all but insures introduction of air into a victim's lungs. The primary shortcoming of other methods under field conditions has been the inability of the rescuer to keep the

(*Continued on page* 190)

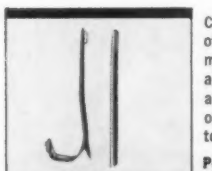
First, clear mouth, throat . . .

Pull jaw down; insert airway . . .
Establish "breathing" cycle



STOP
ACCIDENTAL CONTACTS in this danger zone

Just as vital to linemen's safety as gloves. Surety Climber and Shoe Guards (by the makers of famous Surety Turn-cuff gloves) provide effective insulation against accidental grounding through the feet —on primary and secondary operations and on treated poles. Shoe Guards are worn alone, too, by ground or underground men and for switch work servicing. "Beats a serious problem," say safety directors of many utilities now using Climber and Shoe Guards; "our men now have full protection and peace of mind." Send for informative literature, today.



Climber Guards made of famous Surety linemen glove stock, guaranteed for 20,000 volt acceptance test. Slip on and off easily. Cut to fit any climber.

Pat. No. 2,262,394

Shoe Guards made of special formula to provide maximum protection. Guaranteed for 10,000 volt acceptance test. Low cut for comfort and ventilation — weigh only 2 lb.

Send for Complete File Folder of Surety Linemen's Safety Equipment including gloves, blankets, sleeves, etc. Write today.

THE SURETY RUBBER CO.
CARROLLTON, OHIO

Breath of Life

(Continued from page 189)

TUBE-AND-AIRWAY DEVICE is being carried on some EPB trucks

air passage in the throat and neck open during application. Thus, it is expected the mouth-to-mouth or airway-to-mouth technique will outmode previous pressure-type methods. The back pressure-arm lift method definitely is on the way out. The American Red Cross has been recommending mouth-to-mouth rescue for small children for at least two years.

A second important factor favoring mouth-to-mouth resuscitation is the tidal volume of air exchange. The new technique exchanges air at a rate of about 2,000 cc per inhalation, as against about 1,055 cc per stroke in the back-arm lift method and less than 500 cc per stroke in the older Schafer method. Thus, oxygen level in the victim's blood may be raised quickly.

The mouth-to-mouth method requires less physical effort on the part of the rescuer.

In cases where the victim had broken bones in the shoulder or upper chest area, only the less-efficient Schafer method could be used in the past. To apply back-pressure methods successfully, a flat space the size of the victim and rescuer is needed.

Mouth-to-mouth or airway-to-mouth resuscitation may be practiced with the victim in almost any position, as all the work is done at the victim's face.

CIRCLE 84 ON READER SERVICE CARD

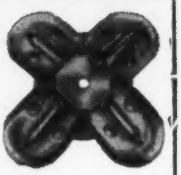
FOR RUGGED DEPENDABILITY
Specify Grip-Tite
EXPANDING
EARTH ANCHORS

Exclusive Grip-Tite *wing* dimples, plus deeply embossed base plate, distributes stress evenly resulting in greater holding power.
Four-Way Design places a greater portion of expanding area into undisturbed soil and yields more holding power in average soils.

Come To Us With Your Anchoring Problems

Grip-Tite anchors come with *nut retainer*. Prevents anchor from sliding up the rod during installation. Permits salvage, too.

Exclusive double-strength anchor top prevents damage from expanding tool during installation.



DEPENDABILITY AT LOW COST
STEEL EXPANDING Grip-Tite ANCHORS
Grip-Tite MANUFACTURING CO.
BOX 111 WINTERSET, IOWA

CIRCLE 176 ON READER SERVICE CARD

MULTI-AMP® takes

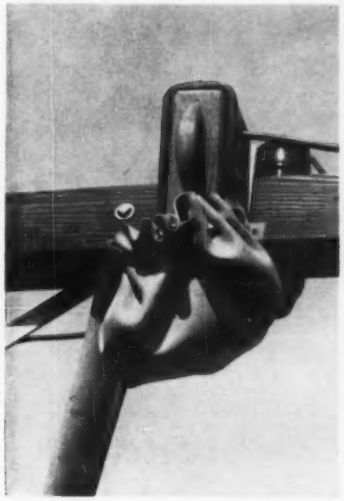
MULTI-AMP
UNIVERSAL
PORTABLE TEST SETS
for OIL CIRCUIT RECLOSERS

Standard Ratings
4, 7.5, 15 Kva

MULTI-AMP Division
MULTI-AMP ELECTRONIC CORP
465 LEHIGH AVENUE • UNION, NEW JERSEY

Send for detailed literature

CIRCLE 177 ON READER SERVICE CARD



Rubber Hood Covers Energized Cutouts

T. E. DAVIS, Supervisor of Safety, Personnel & Training, Electric Distribution Dept, Cincinnati Gas & Electric Co, Cincinnati, Ohio

Safety cover made of ⅛-in. pure rubber was developed by Cincinnati Gas & Electric Co to prevent accidental contacts with energized parts of cutout boxes. The cover has an elastic band around the top to hold it snugly on 2.4-kv or 4-kv cutout boxes. Improved models of the cover now are furnished to CG&E by W. H. Salisbury Co.

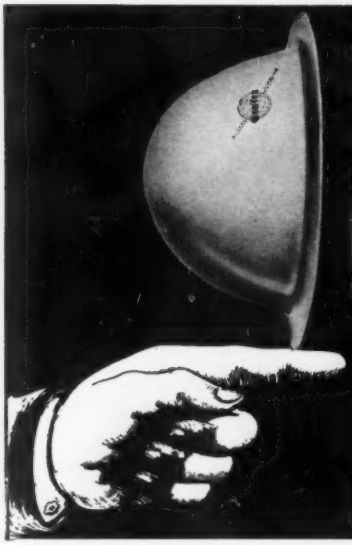
Need for a safety cutout cover was found necessary following fatalities to two linemen. One lineman, in changing position on the pole, got the D-ring of his body belt into an open cutout box. Another lineman contacted the bottom of the cutout box with the top of his head.

The rubber cover is flexible enough to cover the entire box with the lid off, or the tail of the fuse projecting from the bottom of the box when the cutout is closed. In-service experience has shown that a cover stretched over a box cannot easily be knocked off by linemen working on the pole. Covers are carried on all overhead line trucks with other rubber protective equipment and are doing a satisfactory job.

CIRCLE 85 ON READER SERVICE CARD

(More Safety on page 192)

CIRCLE 155 ON READER SERVICE CARD



dielectric resistance breakdown over

25,000 VOLTS

yet weighs

ONLY 12½ OZ.

for all day, every-day comfort

NEW GENTEX ALL-PLASTIC SAFETY HAT
for high-voltage protection.

more protection with less weight through GENTEX research-for-safety

Far exceeds all Government standards and E.E.I. specifications for rugged, safe protection — made of GENTEXITE plastic. No holes, bolts, rivets or metal in crown, brim or sling to create electric shock hazard.
MEN LIKE ITS COMFORT • THEY WEAR IT. Permanent non-wrinkle headband. Instant snap-in, fingertip-adjusting washable head-cradle sling. Handsomely styled in green, gray, white, yellow, blue.

YOU CAN BET YOUR LIFE ON A GENTEX

Send today for a test hat and full specifications
Ask about our lightweight, washable winter liners.
WORLD'S FOREMOST MANUFACTURER
OF HELMETS FOR THE MILITARY

GENTEX CORP. Dept. W, 450 Seventh Ave., N. Y. 1, N. Y.

CIRCLE 178 ON READER SERVICE CARD

Nothing Beats It For Fast, Low Cost Digging

Here's a front and rear view of the more powerful, compact 4T Vermeer Pow - R - Ditcher in action. If you are looking for a low cost, rugged, time - saving ditcher, take a look at the 4T before you buy.

Vermeer Model 4T POW-R-DITCHER

This rugged, self - propelled Pow - R - Ditcher is only 48" wide, 6' high and 13' long and can be transported in a pickup truck. A "midget" ditcher that is ideal for laying gas, water and narrow service lines. The 4T is highly maneuverable — digs 6" to 14" wide and down to 4½' deep.

WRITE FOR COMPLETE INFORMATION, LITERATURE AND LOW PRICES ON THE COMPLETE POW-R-DITCHER LINE.

VERMEER MANUFACTURING CO.
1472 W. WASHINGTON • PELLA, IOWA

Fiberglass Ladder Promotes Safety

H. DREES, Safety Instructor, Cleveland Electric Illuminating Co, Cleveland, Ohio

In-service tests are being conducted on a light-weight fiberglass ladder in two districts of Cleveland Electric Illuminating Co. Should these tests prove successful, the electrical construction and maintenance crews will use the ladders, in 14-ft and 20-ft lengths, to promote greater safety in work on steel towers and substation structures. A construction-maintenance crew in one district has used one ladder for work in steel substation structures at positions that cannot be reached by an aerial ladder. The fiberglass ladders are made by American Allsafe Co, Inc.

The ladder consists of hollow side-rails of fiberglass, with a special device for locking the tubular steps into the rails. For use by CEI Co, the ladders have metal hooks attached to the ends. A 10-ft ladder plus metal hooks weighs about 36 lb; a 20-ft ladder with hooks about 53 lb.

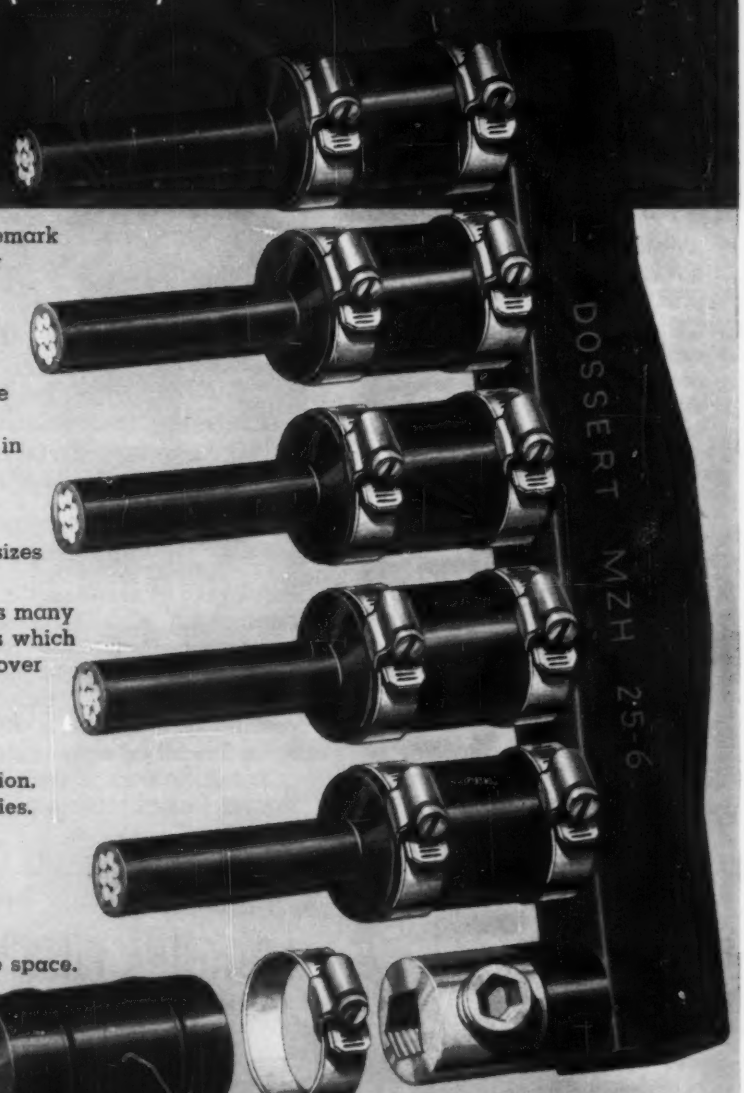
Laboratory tests of the fiberglass ladder made by CEI Co prior to the in-service testing developed these conclusions. Construction of the ladder is adequate to insure safety under normal use. It meets requirements of ASA code A-14.2. The ladder has sufficient strength for normal loading conditions. It has excellent insulating properties, showing 1.4-milliamp leakage current at 100 kv. Use of yellow rungs instead of gray (of side rails) would aid visibility and usage.

CIRCLE 86 ON READER SERVICE CARD

DOSSERT MICON*

(Tapeless Underground Connector)

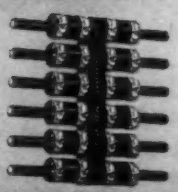
More COMPACT
More RELIABLE
LOWER in COST



MICON is a Dossert Mfg. Corp. trademark for a tapeless underground connector especially designed for residential and industrial underground distribution systems. This brand of connector is fully insulated for joining up to 8 electrical cables where watertightness must be insured. MICON tapeless connector is simple in concept and well proven principles have been used in its design. No extra components are needed to accommodate a wide range of cable sizes in any outlet position.

MICON brand tapeless connector has many outstanding features and advantages which constitute a substantial improvement over older style and competitive fittings. The most important ones are:

- Lower cost of complete fitting.
- Less field time required for installation.
- Wide cable range without accessories.
- No plastic parts to crack or chip.
- No extra bushings required to fit different insulations.
- All parts are designed for easy accessibility and easy installation.
- Compact design conserves manhole space.



Dossert MICON brand tapeless Crab-type Connector is especially designed for joining up to 12 electrical cables. This connector is an original Dossert design and adheres to the same principle as the tapeless type. Write for special catalog.

Request also complete UNDERGROUND CATALOG UG 53-1

*Pat. Pend. Reg. Trade Mark applied for

50

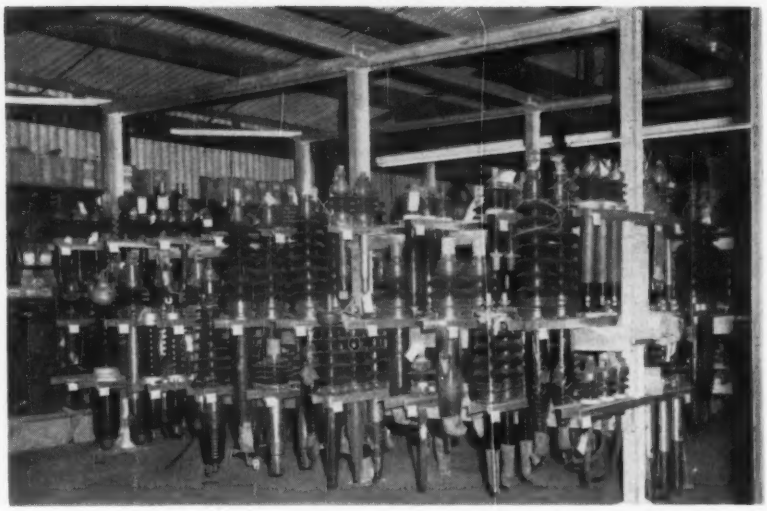
DOSSERT MFG. CORP.

249 Huron Street, Brooklyn, New York

CIRCLE 157 ON READER SERVICE CARD

Store Bushings Safely, Efficiently

JOHN C. HERBERT, *Manager, Purchasing and General Services, Potomac Electric Power Co, Washington, D. C.*



COMPACT AND SAFE STORAGE is provided for 900 bushings by simple racks. One man can place or remove a bushing from any position on the rack

Compact and low-cost racks provide safe and efficient storage for all but the largest bushings used by Potomac Electric Power Co. Racks are designed so that one man can remove or store a bushing from among up to six different types or sizes of transformer or oil circuit breaker bushings.

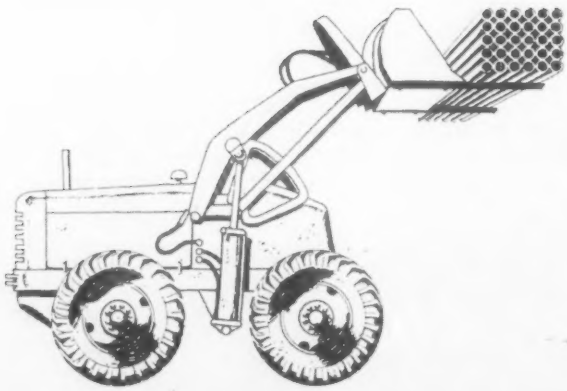
Each of six racks consist of 6-in. steel I-channels serving as the main frame. Tops of supporting 6-in. vertical channels are joined by an I-channel for added rigidity. Placed between the channels are 3x4-in. angles to support vertical channels and bushing supports.

Placed crosswise on the main frame are sections consisting of 2x2-in. and 2½x2½-in. angles. These are spaced from 4½ in. to 9 in. apart to allow the bases of bushings to be placed on the sections. Each bushing placed in the section is described on a card placed in a metal holder fixed to the section. A list of the contents of each rack is affixed to the face of the rack.

Storage sections in the middle row are located between pairs of sections in both upper and lower rows so that bushings which are long and/or heavy may be stored conveniently either in the bottom or middle sections. All joints in the racks are welded except for post plates which are bolted to the floor. The six racks require only 9,300 cu ft of storage for a maximum of 900 bushings.

Bucket Attachment Handles Fiber Duct

H. HUMPHRIES, Construction Superintendent, Connecticut Light & Power Co, Berlin, Conn.



An attachment that adapts a bucket tractor to double as a fork lift has speeded up unloading of fiber duct for Connecticut Light & Power Co. It permits CL&P to purchase fiber duct in bundles and unload it quickly.

The attachment, designed and fabricated by company employees, consists of two square steel bars attached to, and projecting out 24 in. from the bottom edge of the bucket. A safety sling fastens around the duct to the top of the bucket.

Previously, duct was purchased in bulk and unloaded by hand. Not only was this slow, but also some employees appeared to be allergic to the duct.

(More Stores & Shops on page 195)

SPOTS TROUBLE ON THE DOUBLE

NEW ALLIS-CHALMERS insulating oil TEST KIT

Now you can quickly *spot-check* the service condition of transformer and regulator oils with the new Allis-Chalmers Field Test Kit. Use this simplified oil spot comparison kit to measure and interpret both acidity and polar contamination for extent of oil sludging. You save unnecessary lab analysis delays and costs. Tests indicate when complete lab analyses are needed.

Acidity test determines acid content as a gage of oil aging.

Polar compound test determines the extent of contaminating materials present resulting from oxidation (related to interfacial tension).

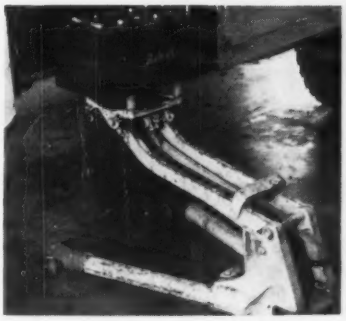
Insulating Oil Test Kits, priced at only $15.00, can be obtained through your Allis-Chalmers representative or write: *Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin.*

Simple, accurate insulating Oil Test Kit contains: acidity buffer, acidity indicator, polar compound indicator, medicine droppers, filters and test rings packed in a sturdy 7" x 9" x 2½" steel carrying case.

ALLIS-CHALMERS

A-1049-E

CIRCLE 179 ON READER SERVICE CARD



Jack Adapter Helps Handle Batteries

GEORGE H. IRISH, Chief, Transportation Branch, Tennessee Valley Authority, Chattanooga, Tenn.

An adapter, designed to fit over a gear box lift, helps TVA personnel handle large batteries. The unit shown was designed by TVA's Walter A. Wood to fit an Aerol gear box lift.

A 10x16-in. plate has pipe sections welded on to fit over the standard lift screws. Adjustable supports permit levelling the battery, and chains attached to the lift are used to secure the load. One man can handle large batteries or other items that ordinarily require two men.

CIRCLE 87 ON READER SERVICE CARD

Dunnage Truck Controls Scrap

A dunnage truck, built from an ordinary pallet, improves dunnage control for Lowell (Mass.) Electric Light Corp. The truck can be pushed to a storeroom location where stacking or dismantling is taking place and the dunnage removed with a minimum of time and labor.

Four pieces of dunnage are used as corner braces for the pallet base. Scrap lumber is used to board in the sides. One side is left partially open so that dunnage can be reached easily. When equipped with wheels the truck is ready for use.

(More Stores & Shops on page 196)

SUPERVISORY GROWTH

How a supervisor thinks and acts, the way he handles people and problems, is felt far beyond the confines of his own area of operations. It "echoes" throughout your entire organization.

Because he is your personal representative at the work level, expanding the supervisor's capacity to manage is an important objective.

Assisting him to grow and develop assures the kind of performance that reflects itself in higher returns from company payroll dollars.

This is the job **MANAGEMENT INFORMATION** does. Here is a practical program based on mind-stretching material geared to today's needs.

Specifically designed to help the supervisor help himself.

Why not determine for yourself the value in **MANAGEMENT INFORMATION** by requesting your personal copy of "Supervisory Growth." Not just a brochure but a value-packed sampling of actual motivating material including:

- 50 page Pocket Planning Guide
- Skill in Taking Initiative
- 100 Ways to Cut Waste
- Motivation
- Case Studies

WRITE for your personal copy today!

Elliott Service Company, Inc.
Dept. W-1
Mount Vernon, N. Y.

Please provide me, without obligation, with a copy of "Supervisory Growth."

Name .....

Firm .....

Address .....

City .....Zone ....State .....

CIRCLE 159 ON READER SERVICE CARD

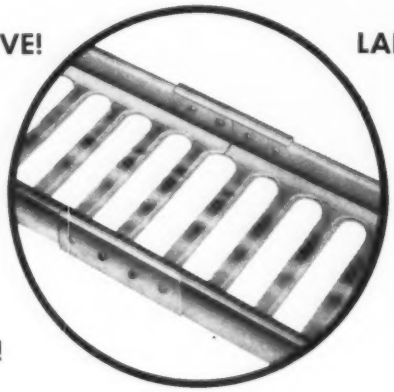
Now P-W BRINGS YOU TYPE "E" TRAYS TO HOLD POWER AND CONTROL CABLES AND INSTRUMENT PIPING . . .

LESS EXPENSIVE! **LABOR SAVING!**

STRONGER! **NEATER!**

VERSATILE! **SUPERIOR!**

GALVANIZED! **ALUMINUM!**



Control cables can be dropped out anywhere. Eliminates conventional drop-outs. Furnished in standard widths: 1½" and 3" high in galvanized steel and 3" high in aluminum.

With Type "E", P-W brings *you* another *First*. P-W has been the leader in outstanding improvements in cable and tubing supports, among which are: Connectors that are quick and easy to put together with drive rivets. A pre-cut system that saves countless hours in installation time. Extension Connectors to eliminate field cutting in completing runs. Adjustable Horizontal and Riser Connectors so workmen can make runs over and around pipes, trusses, columns, etc. (Of great advantage in areas and buildings to go in and around circles, spheres, tunnels, etc.) Built-in Adjustable Drop-out Sections for power and control cables—eliminates cutting out bottom of tray to install conventional drop-outs. Straight sections can be purchased in lengths up to 16' (33⅓% less connectors and 33⅓% less connection-installation time over 12' lengths).

P-W also manufactures supports (hot dip galvanized steel and aluminum) in Ladder, Expanded Metal and Solid Trays. All systems, including Type "E", are interchangeable. Write for Catalog No. 858.

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196 CIRCLE 160 ON READER SERVICE CARD

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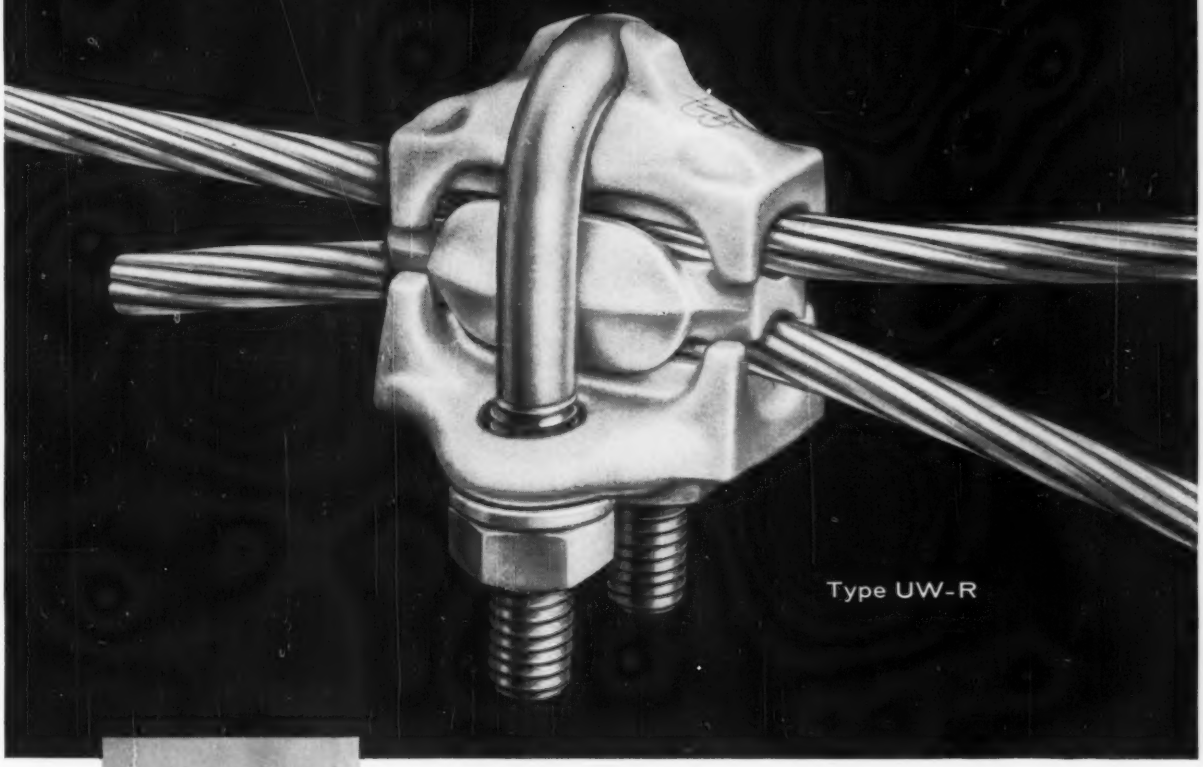
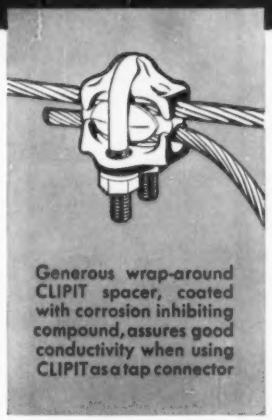
low cost DEADEND for ACSR and Aluminum



Type UW-R



Generous wrap-around CLIPIT spacer, coated with corrosion inhibiting compound, assures good conductivity when using CLIPIT as a tap connector

The high strength aluminum alloy CLIPIT deadend offers low cost, easy installation, wide range and versatility.
For reliable field performance, the CLIPIT, type UW-R, has these engineered features:

- Wide cable range: 2 sizes cover #6 thru 2/0 aluminum or 1/0 ACSR.
- High holding strength—CLIPITS exceed rated breaking strength of ACSR on most sizes.
- All parts of the CLIPIT are mutually self aligning.
- Captured, high strength, galvanized steel U-bolt permits high tightening torque.
- Wide belled cable entrances of CLIPIT reduce stress points and minimize cold flow. Ears of caps confine cables, prevent splaying.

CLIPIT— *another engineered solution to your connector problems by*

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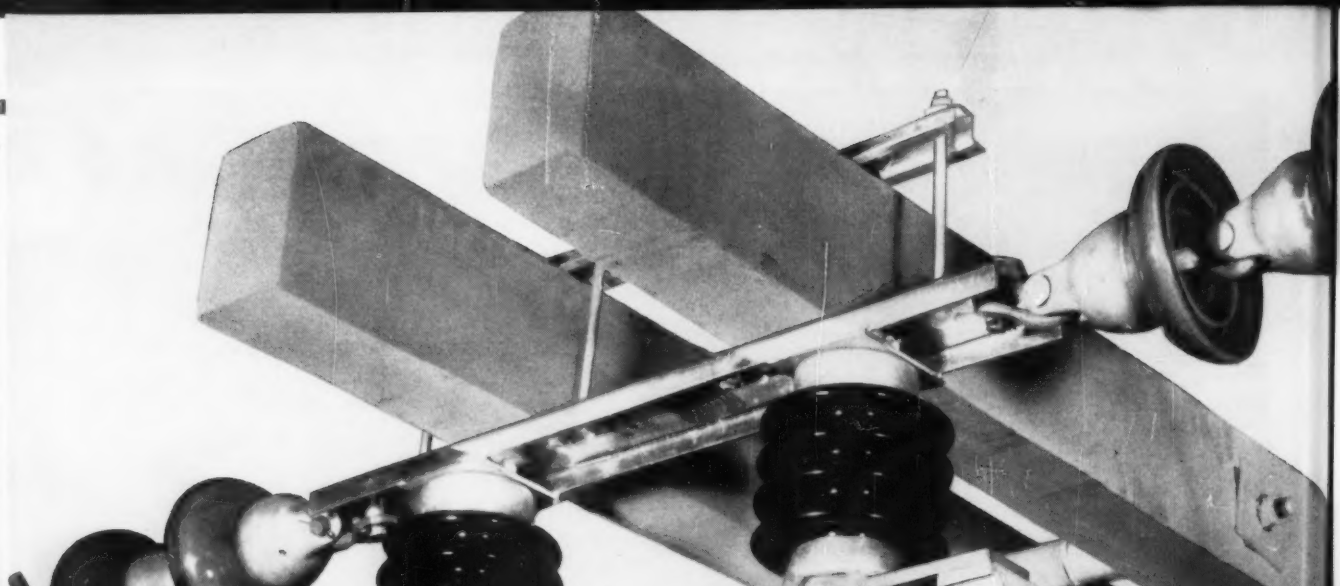
58-13



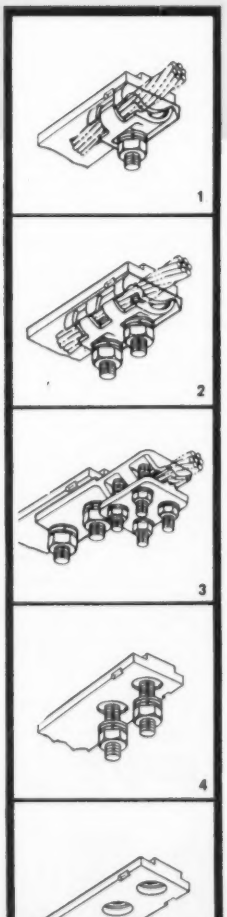
S&C LOADBUSTER DISCONNECT rated 400 amps continuous, 15 kv, 95 kv BIL. For use with LOADBUSTER® S&C's portable loadbreak tool

Now with S&C LOADBUSTER DISCONNECTS you have widest choice of connectors

No matter what your connector preference, you can satisfy it with S&C's LOADBUSTER DISCONNECTS. Here's why: You can get a choice of two new styles of groove-type connectors (details at right) and three NEMA Standard pad terminal connectors. Not enough?

You can also have the LOADBUSTER DISCONNECT with aluminum or bronze captive bolts—an S&C first—for hot-line tool installation of compression connectors. Or, if you prefer, you can obtain this disconnect without any connectors or connector hardware.

For more details please write for Bulletin 721. S&C Electric Company, 4421 Ravenswood Ave., Chicago 40, Ill.



1. NEW Bronze groove-type connector. Single bolt, captive for hot-line tool handling. Takes No. 2 solid through 500 Mcm stranded copper.

2. NEW Aluminum alloy groove-type connector. Zinc-tin plated, two bolt, captive for hot-line tool handling. Takes No. 2 solid copper through 500 Mcm stranded copper or aluminum.

3. NEMA standard pad terminal connectors for copper conductor. Three sizes: No. 6 solid through 2/0 stranded; 2/0 solid through 4/0 stranded; and 250 Mcm through 500 Mcm.

4. NEW Aluminum or bronze captive bolts. Will take your choice of connectors—compression or other types.

5. NEW. Any connector can be used with this terminal pad. It has standard NEMA drilling—two 9/16" holes on 1¾" centers.

S&C ELECTRIC COMPANY

CIRCLE 162 ON READER SERVICE CARD

Logic Static Switching Promises Better Industrial Load Control (*Continued from page 99*)

An automatic regulator will tend to maintain the terminal voltage, up to the ceiling voltage of the excitation system.

An earlier experience at the refinery demonstrates the possible vulnerabilities created by increase in system size and complexity. Before the system grew to its present size, Loads M and N, with their respective associated ties lines and feeders C and D did not exist. At the time of the incident, total refinery load was 30,500 kw, of which 22,000 was supplied by local generation.

Both incoming lines were accidentally tripped at the power company. No reverse power flowed; no refinery breakers tripped; no alarms operated, and no one in the refinery was immediately aware of what had happened.

No one, that is, except "George", an operator at a comfortable, quiet pumping station. He noticed a change in sound which, "Occurred quite rapidly, in about two or three seconds." He called the power plant and said, "Sounds to me as though the pumps have slowed down a little. Is everything okay?" The power plant operator saw that the frequency meter was off scale, below 58 cycles, and immediately dropped enough load to restore the normal frequency. The entire process required about three and one half minutes.

System Drops 25% of Load

In reconstructing the incident, it was found that when the utility supply was lost, the generators were overloaded by about 0.4 per unit. They immediately started to decelerate at the rate of about three cycles per second. As the system slowed, it unloaded itself so that the actual deceleration reached a final stable condition of approximately 54 cps, as shown by Curve A, Fig 2.

System voltage dropped about 6%. The generators were able to carry about 22,800 kw at this reduced frequency and voltage for about three and one half minutes without difficulty. The 7,700 kw load reduction—about 25%—due to speed reduction, was produced by a frequency drop of 10% with a load assumed to vary as the 2.75 power of speed, mostly centrifugal pumps. Curve A, in Fig 2, closely agrees with the initial Curve B. In the present system, with approximately 60 MVA total load, it is obvious that unloading by the "George" method would be cataclysmic.

Fig 4 shows the static switching circuitry used to protect the system against the loss of the utility power supply. One pair of underfrequency relays, UF1 and UF2, are installed in each bus section of L. UF1 is set to pick up at 59.5 cps; UF2, at 58 cps. Left and right UF1 provide inputs to the "OR" logic unit 1. This provides a safeguard against one relay failing to operate. No harm is done if a relay operates when it should not, since no load is dropped.

False Operation Averted

The output of "OR" unit 1 operates through "OR-Relay" combination 6 to separate the power system between Bus M and N. It also provides one-half the input to "AND" unit 3. If a major disturbance is iminent, there is no hope of saving the 18,000-kva "N" load. Thus, removing it from the local generator load and letting it sink or swim with the utility supply is advantageous.

If the frequency continues to drop, the UF2 relays pick up and, through "OR" Unit 2, provide the other half of the signal for "AND" unit 3. The output of "AND" unit 3 provides half the input to AND unit 4. It also provides the input to "OR-Relay" combination 7, which opens the incoming lines A and B and initiates programmed load shed on K, L, and M buses down to the generator capacity. By using UF1 and UF2 signals through an "AND" unit, false operation either way is prevented.

If generator No. 4, rated 9,000 kva, is down, the "A" contacts on the main breaker remove the input from "NOT" unit 5, which provides the other half of the input to "AND" unit 4. The "OR-Relay" combination 8 then drops an additional programmed 9,000 kva.

Fig 5 shows the frequency change, beyond the frequency relay setting, for three events to occur, assuming a constant rate of system frequency change. Curve 1 shows the system frequency change that takes place while the frequency relay is operating to close its contacts. Curve 2 shows the change in system frequency during the time required for a 5-cycle breaker to operate. Curve 3 shows the total system frequency change during relay time, breaker time, and static logic switching time.

A 2.0 per unit excess load, which is easily possible, is shown to be controlled by the time the power system frequency reaches 52.5 cps. It is probable that this level would not be reached, since the load is mostly centrifugal pumps and the system would tend to decelerate slower than the initial rate shown in Curve D, Fig. 2.

The design criteria for system supervision for other contingencies are simply stated: Feeders A, B, C, and D are to be protected against overload by alarm at 100%, and by load reduction at 125%. Tie lines between buses K, L, M, and N are protected by alarm only.

Corrective Action Is Discrete

The basic control philosophy is discrete step binary, (e.g., off-on or yes-no), combined with feed-forward control. Any combination of contingencies provide inputs to the logic section where one correct decision is made. The output dictates discrete corrective action. In this case, overload reduction is achieved by first separating the power system so that full use can be made of the feeder capacity. If the overload persists, programmed load shed is used until the load is brought within range.

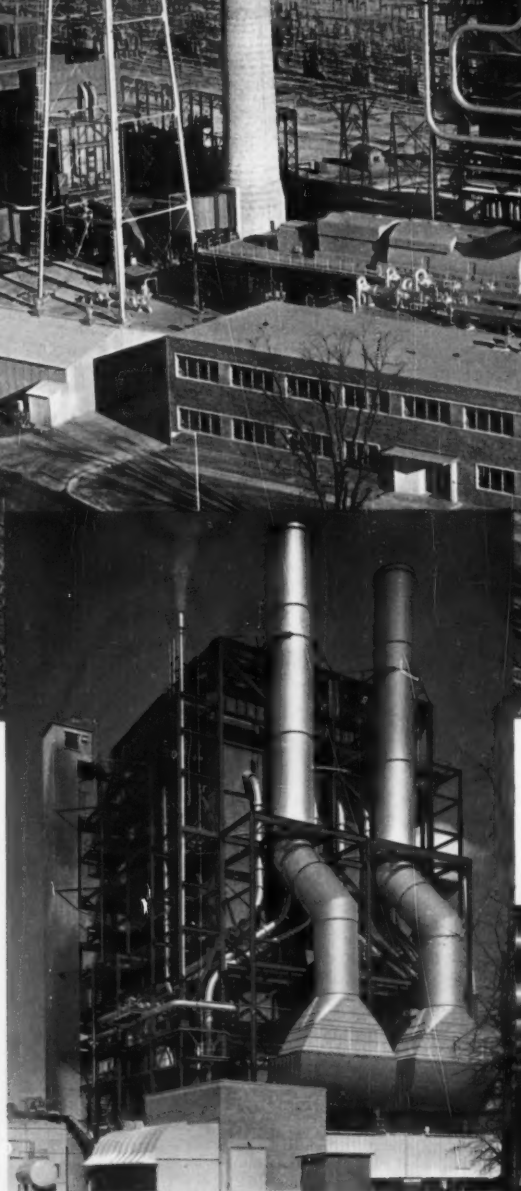
In general, the order in which loads are dropped is decided by the operating department. Priorities were established for all buses interconnected, for separation between L and M, or between M and N. The logic used for the intermixed trip signals is a modified shift register—borrow or carry—circuit borrowed from the digital computer field.

Ohio Ed Hike Approved

Youngstown, Ohio, city council approved a 6.5% rate increase for Ohio Edison Co. The hike is the same granted by Akron recently. Ohio Ed sought 7.2% in Youngstown.

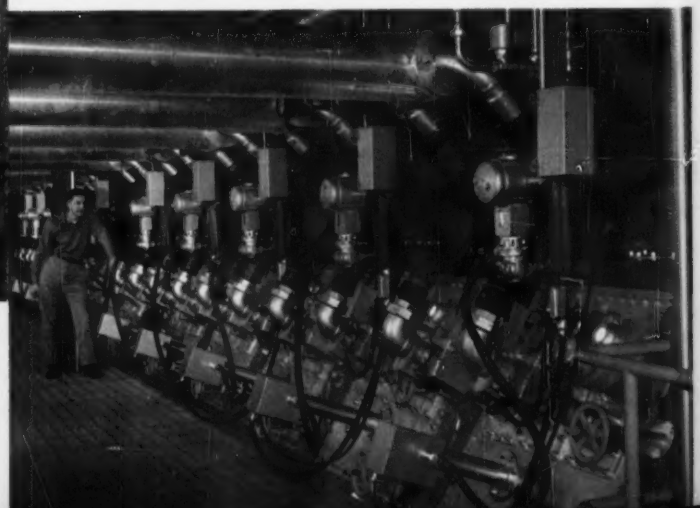
One TURBO FURNACE

The Riley Turbo Furnace Boiler is dominant structure at Sterlington Steam Electric Station near Monroe, Louisiana.



Weather resistant, colorful porcelainized panelling covers setting buckstays.

Ten of twenty Riley Directional Flame Turbo Furnace Burners. Opposed firing produces turbulent flame at uniform level across full 56 feet of furnace width. Each burner is equipped with remote automatic shut-off and flame sensing devices.



Leads to Another–

Performance at Sterlington, La. Is Basis For Decision To Install 1,650,000 lb/hr Turbo Furnace Boiler At Push-Button Operated Little Gypsy Steam Electric Station.

Louisiana Power & Light Company's new Little Gypsy Station is scheduled to go into operation early in 1961. This pioneering plant will be completely push-button operated. The design of the 1,650,000 lb/hr Riley Turbo Furnace to be installed is based upon the following exceptional operating characteristics of the 1,550,000 lb/hr Turbo Furnace at Sterlington Steam Electric Station.

Low air heater exit gas temperatures — high unit efficiency.

Low forced draft fan pressures — low auxiliary power.

A flat superheater and reheater metal temperature traverse across full furnace width.

Primary and reheat temperatures maintained from below 50% load to full load.

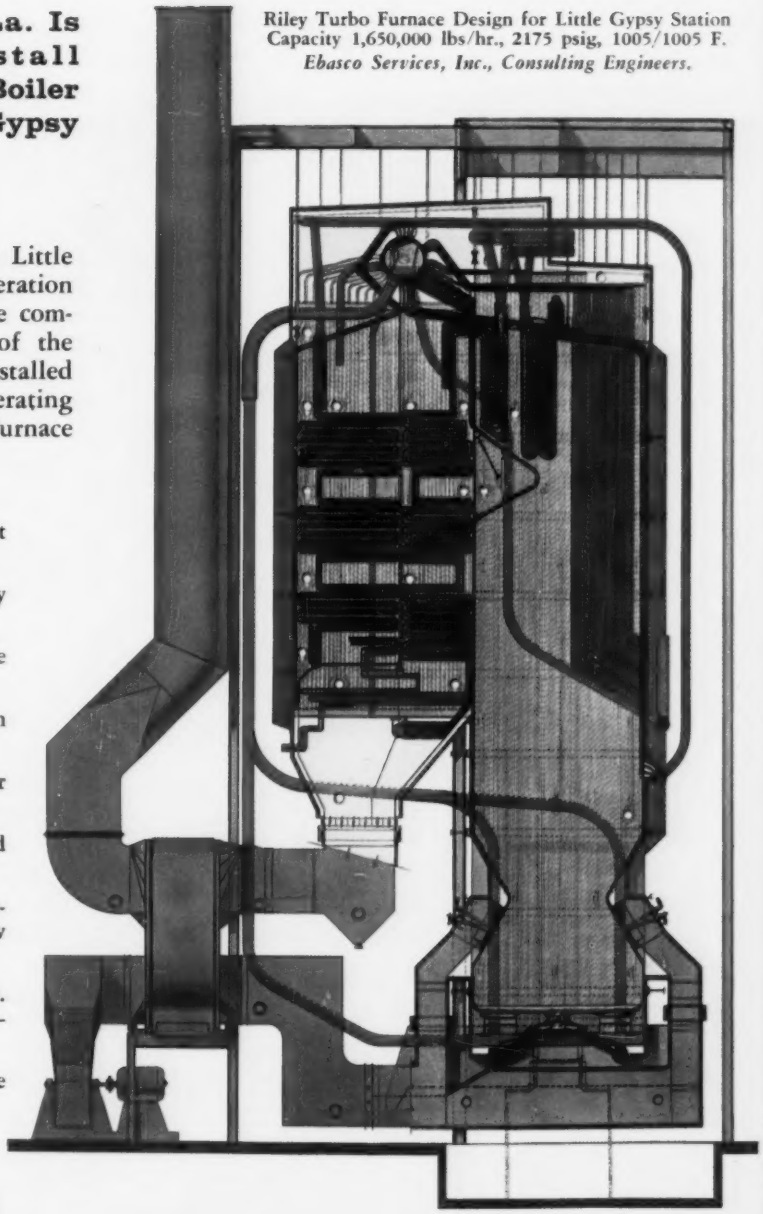
With bottom firing — full utilization of water wall surfaces.

One level firing provides ease of observation and operation.

Gas burns with luminous flame with similar furnace temperatures as coal — hence, quick and low cost conversion to coal firing is possible.

With coal firing flyash is reduced to a minimum. With continuous slag tapping and reinjection — carbon loss is negligible.

With coal firing an exceptionally clean furnace is maintained.



Riley Turbo Furnace Design for Little Gypsy Station
Capacity 1,650,000 lbs/hr., 2175 psig, 1005/1005 F.
Ebasco Services, Inc., Consulting Engineers.

Monitoring at Sterlington Sets Stage For Complete Automation at Little Gypsy

At Sterlington, digital scanning, logging and computation of temperature conditions and other operating factors of furnace, boiler, turbine, generator, feedwater, and auxiliaries are the basic elements for complete automation of the Little Gypsy Steam Electric Station. Procedure, with audible and visible alarms, enables one operator in a centralized control room to make proper decisions for safe and efficient operation of entire plant. The operating characteristics of Riley Turbo Furnace Boilers are ideal for automatic push-button plant operation.

A survey of your plant by qualified consulting engineers could show ways of making substantial savings in your power costs.

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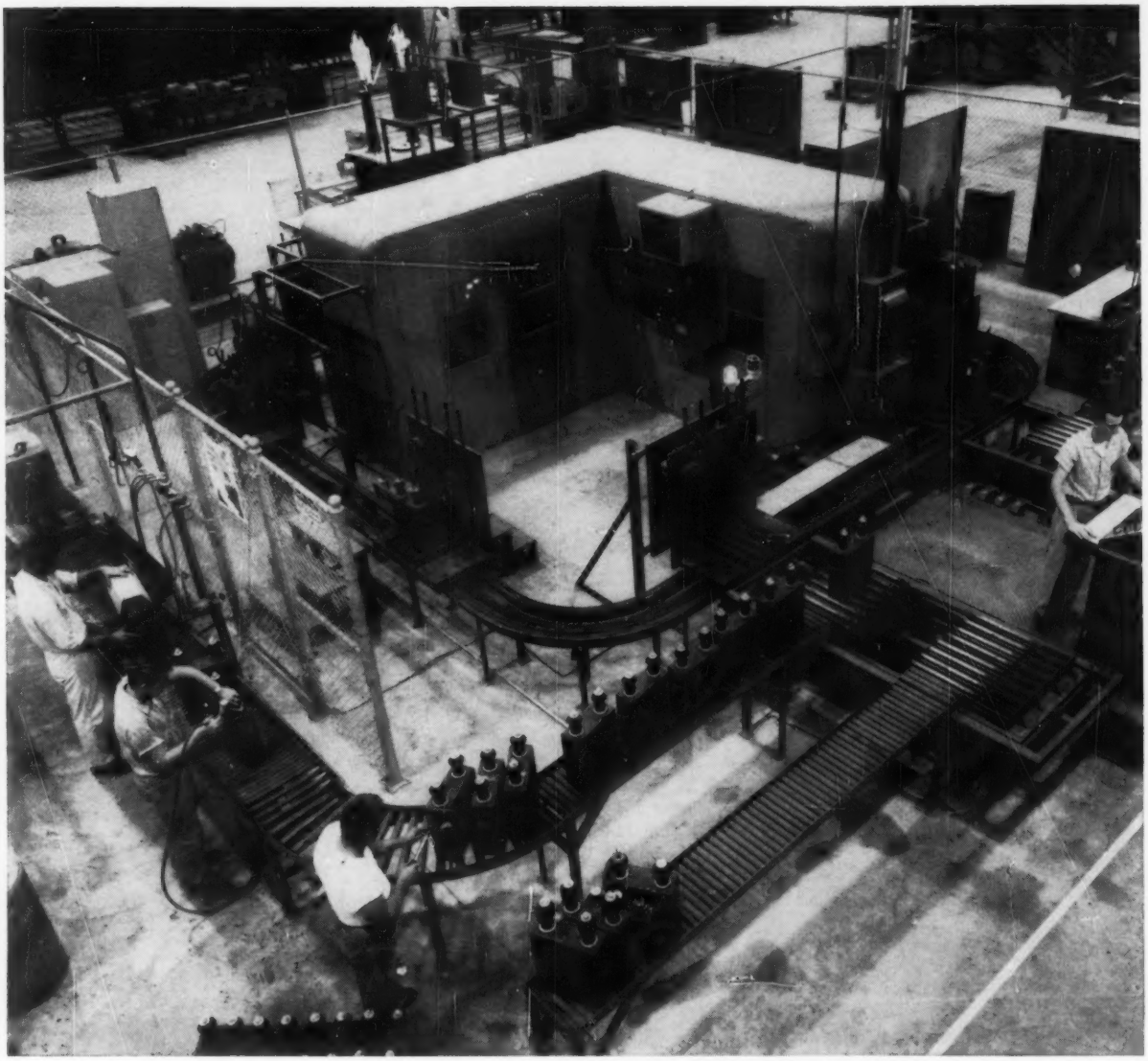

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To give you the most in long capacitor life and dependability, Westinghouse has eliminated human error from quality control at the new Distribution Apparatus Plant at Bloomington, Indiana. An automated testing facility* administers a series of rigid tests to every capacitor produced on the line, climaxing a total of eight other quality control checks made during production.

A sequenced conveyor carries the capacitor through six test stations: capacitance, 60-cycle overpotential, d-c overpotential, 25-cycle overpotential, resistance, and finally a recheck of capacitance. At the end of the testing cycle, the unit is automatically sent to the shipping area, or rejected if faulty.

A punch card automatically programs the sequence of tests required for each type of capacitor.

Through this automated system, you are assured of the highest quality and reliability in your capacitor equipment.

For information on capacitors, call your Westinghouse representative or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-60940

**This testing equipment, called OPCON, recently received the Industrial Science Achievement Award from the American Association for the Advancement of Science.*

YOU CAN BE SURE...IF IT'S Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV MONDAYS

How West Penn Builds Managers

Report on
Management Development

West Penn Power Co has brought a new approach to management development, with a school that offers a unique combination of professional instruction and courses "tailor-made" to fit the specific needs of the company's managers. The school is located at Granville, Ohio, in peaceful surroundings outside the company's service area. It has been attended by a large proportion of the company's managers—on a schedule which allows them to attend without losing touch with their regular duties back at the company.

The school is only a part of West Penn's management development program, but it is an important part. Last winter and this spring, 76 managers from West Penn Power, plus seven from the parent West Penn Electric Co, Monongahela Power Co and Potomac Edison Co, completed the school, which is designed to help managers improve their own job performance and get ready for bigger jobs in the future. West Penn management—those who attended the course as well as those who set it up—have been well pleased with results.

It all started in 1954, when West Penn revamped its organization. Operating departments were decentralized, and geographical divisions were consolidated into larger packages. These changes added to the responsibilities of existing jobs and created new management positions. The reorganization focused a sharp beam on the need for fully qualified replacements ready to step into positions of greater responsibility as they open up. West Penn's answer was a broad program of management development.

Like any other utility, West Penn has its share of vacancies created by retirements, resignations, death, and disability. West Penn has found also that the company's natural growth produces enough new jobs to account for twice as many promotions as vacancies do. From 1955 through 1958, the company's records show 259 upward transfers in management. Only 70 of these came as result of departures, the other 189 stemming from growth within the organization. As further proof of the need for managers, in that period West Penn elected a new president, seven new men for the executive staff; there

Planning a Management School? Here Are Some Hints:

1. Find out what courses your managers really need before deciding on a curriculum. West Penn studied histories, performance appraisals, tests, and interview reports of prospective students before choosing topics.
2. Choose the faculty with care, on the basis of specialized knowledge and teaching skill. Brief them thoroughly in advance on scope of their subject, education and experience of students, background of company philosophy, objectives, and policy.
3. The school should be free from distractions. West Penn found its school location, quiet and away from job pressures, was conducive to concentration on learning.
4. Schedule attendance so that participants can be spared from their jobs. West Penn arranged the school at a time when seasonal work load was least demanding. Staggered attendance allowed a more rigorous schedule than would have been possible in a solid four weeks, and let company operate with never more than 1/3 of key supervisors absent.
5. Make assignments to small discussion groups on basis of management level, organization, line or staff, geographical location. No man was put in the same group with his boss.
6. Two or more neighboring utilities with similar educational needs might organize such a school cooperatively, West Penn feels.

were 21 promotions to general staff level, 64 among immediate subordinate managers, and 166 in the lower management ranks. These promotions affected nearly half of West Penn's management—and an even faster pace is expected in the early 'sixties. Recalling the inception of the management development program, Personnel Director James H. Westbrook says: "There was the stark realization that even our managers were mere mortals who were unlikely to outlive the company. Consequently, we needed to pump new blood of high quality into the bloodstream at a faster rate."

The idea for the management school had its roots in a broad appraisal of the specific needs of West Penn managers that was conducted in 1955. This appraisal involved self examination, review of performance, personal history, tests, and interviews of more than 100 managers in the upper levels. After evaluating the information from this study, West Penn started to train supervisors in individual coaching, stepped up its self improvement and educational assistance programs, sent executives to special courses at the University of Michigan, Georgia Tech, Penn State, and to American Management Association seminars.

But the appraisal also revealed some needs common to most managers which seemed to call for some management schooling geared specifically to meet them. The interviews provided the basis for shaping a curriculum that would do just that—filling in the blanks left by institutional courses and relating the whole to West Penn's problems. Planning began for a school which would combine the advantages of college seminar and company group training. Manager of Personnel Development Percy A. Rice explained: "There was no better way to teach the curriculum to so many West Penners in so short a time and also give them the advantage of working on closely-knit teams."

Faculty was selected from universities and industry, with the nucleus coming from the College of Commerce and Administration at Ohio State University. Every member of the 21-man faculty brought industrial as well as teaching experience to the school. Each instructor was briefed on company policy, philosophy, and practices, but West Penn made no effort to discourage conflicting points of view.

The idea of the school was not to "teach at" the participants, but to encourage them to think for themselves and draw their own conclusions. The objectives were to expose them to modern concepts of planning, organizing, directing, coordinating, and controlling; to give them enough drill in using these concepts to appreciate them; to bring out free exchange of experience and opinion among the students; and to encourage each participant to build his own philosophy of management, based in the assigned reading, his own experience, and the experience of the faculty and the other participants.

The 83 managers attended the school in three groups of 25 to 30 each. So that West Penn could meet minimum staff requirements, each participant spent one week at the school, two weeks back at his regular job, another week at the school—until he had completed the four-week course.

Each week of the school began on Sunday afternoon with a bus trip to the site—an inn in a small Ohio town. Participants arrived in time for dinner and an evening of study in preparation for Monday's classes. The typical day started at 9 a.m. with a lecture and then discussion until 11:45 a.m. At 1:15 p.m. the class was divided into smaller groups of five or six persons and sent to separate conference rooms to work out the day's assigned problems. At 3:20 p.m. the entire class reassembled to report and discuss the results of the small group workshops until 4:30 p.m. After supper, each man studied the assignments for the next day's lesson, and at 9:15 p.m. the small groups met again to review and discuss the assigned reading material. The week ended with a Saturday morning session and a return bus ride in the afternoon.

Managers who attended the school agree that the time passed swiftly. They found it rigorous and fatiguing, but also stimulating, interesting, and enjoyable. Despite the full schedule, discussions begun in class were often continued spontaneously through the rest periods.

The school's curriculum shows the breadth of its objectives. Topics covered in the first week included "Business in the American Economy" . . . "Qualifications of a Good Manager" . . . "Policies, Systems, and Procedures" . . . and "Long Range Planning and Forecasting." In the second week, the accent was on organization, with such topics as "Principles of Sound Organization" . . . "The Informal Organization" . . . and "The Delegation Process."

Within each of these topics, the school helped managers to crystallize their thinking about things which were always with them on their jobs, but which did not often come in for close appraisal. Here are some notes on the informal organization, described as "the ever-present, often-frustrating, sometimes-amusing, potentially-valuable structure existing beneath the formal surface organization: Authority and leadership in the informal pattern are earned and usually granted from below or horizontally, compared to the formal pattern where authority is conferred from above. Informal relationships lend themselves to useful purposes which include sources of information, vehicles for conveying ideas, sources of formal managers, and sounding boards for contemplated action."

Topics for the third week included "Direction through Command" . . . "Direction through Appraisal and Development" . . . "Effective Communications" . . . "Motivation and Morale" . . . and "Public and Community Relations." In the fourth week emphasis shifted to control, including "External Financing" . . . "Budgeting as a Control Tool" and finally, "An Overview of Management."

To help relate these topics to specific West Penn problems, the school used a variation of the "case method" for the afternoon assignments. The small discussion groups were given case data from West Penn experience, and requirements for the groups to solve. For example, one case included a set of statistics on power use and revenue for commercial and residential customers and the number of company employees. Each small group was required to make a forecast of

revenue in ten years, state the assumptions on which they based the forecast, and point out areas of personnel and engineering that would be significantly affected if the forecast came true. After each member had read the case, the group—under the leadership of its chairman for the day—exchanged views until they reached agreement. Later, when the groups gathered, each reported its conclusions to the entire class. In another case, participants were handed an editorial published by *Fortune* in 1938 depicting the plight of the business man, whose popularity was then at its lowest ebb. Workshop teams were asked to determine the significance with respect to the development of corporate public relations, to appraise the progress of corporate public relations since 1938, and to decide on its future significance.

There were no examinations, or other formal means of measuring performance. West Penn felt that formal exams would be meaningless in measuring increased breadth of vision, changes in attitudes or sense of values; and these were the aims of the school. The company believes that job performance appraisals, which are made periodically, will reveal the school's effectiveness.

The company is already convinced that the school was worthwhile, however. West Penn President Streuby L. Drumm said: "We are greatly pleased with the results of the management school just completed. Many of the participants have expressed their appreciation for the opportunity of taking part in this stimulating, broadening experience. They feel that they now understand more clearly the broader aspects of the company's business and, as a result, have a better understanding of their own individual responsibilities."

Men who attended the school spoke highly of it in confidential evaluations they submitted after its completion. Sample comments: "The school gave us an opportunity to review current problems, away from immediate job pressures. The stimulation of extra-curricular discussions of such problems was helpful, too." And: "West Penn did well to design a 'company' course, since I benefited greatly from increased acquaintanceship with company organization, policies, and other management personnel."

An overall evaluation came from J. Lee Rice, Jr., President of West Penn Electric. "We believe the investment made in this school will be one of the most profitable the company has made," he said. "It is a substantial step forward in insuring a continuance of capable management of the system."

Each student was issued . . .

. . . the texts shown at left when West Penn's management school began. Basic references were a specially-prepared text book covering the 24 daily topics in the course and a course notebook containing outlines of the lecturers' presentations. In addition, each man received a personal library of nine texts and reference books for his reading assignments. The conference rooms contained more manuals and reference material.

It's Time for Electric Heat to Grow Up!

Resistance heating alone, says the author, is not giving the customer ultimate benefits. He recommends '12-6-6' insulation, lower w-densities and air-handling equipment

GLYDEWELL BURDICK, Secretary, Wisconsin Power & Light Co., Madison, Wis.

It's time for electric heating to grow up!

By that I mean the true potential of electric heating, in terms of the benefits it can bring to customers at minimum obtainable cost, is not being fully exploited.

The electric industry has been having a lot of fun playing with electric heating. Pioneer heating customers enjoy the zone control, cleanliness, safety and convenience it provides . . . but they are not getting nearly the advantages they could enjoy. This is all the more important because general public acceptance of electric heating is just around the corner.

In order to get these maximum benefits I believe we must search and put to practical use the best answers to the following two questions:

1. What house construction and insulation will give the lowest total annual cost to the consumer, considering both operating costs and the annual cost of ownership?

2. What types of electric heating equipment will give the highest quality of comfort service to the consumer in homes constructed as above?

A reasonably good answer to the first question must be known before we can find answers to the second.

Finding the right answers to these two questions will broaden the market; more people will want and be willing to pay for electric heat.

The insulation standard generally recommended now is 6 in. in the ceiling, 4 in. in walls, and 2 in. under floors.

In new construction, this "6-4-2" insulation is represented as the amount required to reach the lowest combined first cost of the insulation and the heating equipment. It ignores the cost of electric energy and assumes that this cost need be given no weight in deciding how to build and insulate a home.

Are we being fair to our customers when we recommend this standard of insulation, knowing that a greater amount will give a lower total cost for electric heating? Furthermore, isn't it to everyone's advantage to recommend higher standards?

Too Much First-Cost Emphasis

My view is that we have been putting undue emphasis on an only slightly higher first-cost obstacle, forgetting the immediate year-by-year offset of lower electricity bills. To correct this is both a job in engineering economics and in education. That in the beginning the educational job may appear difficult is no justification for avoiding it. Given the education, the easiest jobs to sell will be the ones having low total annual cost and high quality results. Five years from now almost no one will consider building an electrically heated home that is not insulated close to the economic balance point, i.e., built according to the best answer to Question 1.

While it may not be as high as the ultimate standard for electrically heated homes, the following is suggested as an intermediate standard which should be considered for

(*Continued on p* 213)

You can use the MODERN TWIST
Preformed GUY-GRIP dead-end
GALVANIZED STEEL
Preformed GUY-GRIP dead-end
COPPERWELD
Preformed GUY-GRIP dead-end
BRONZE
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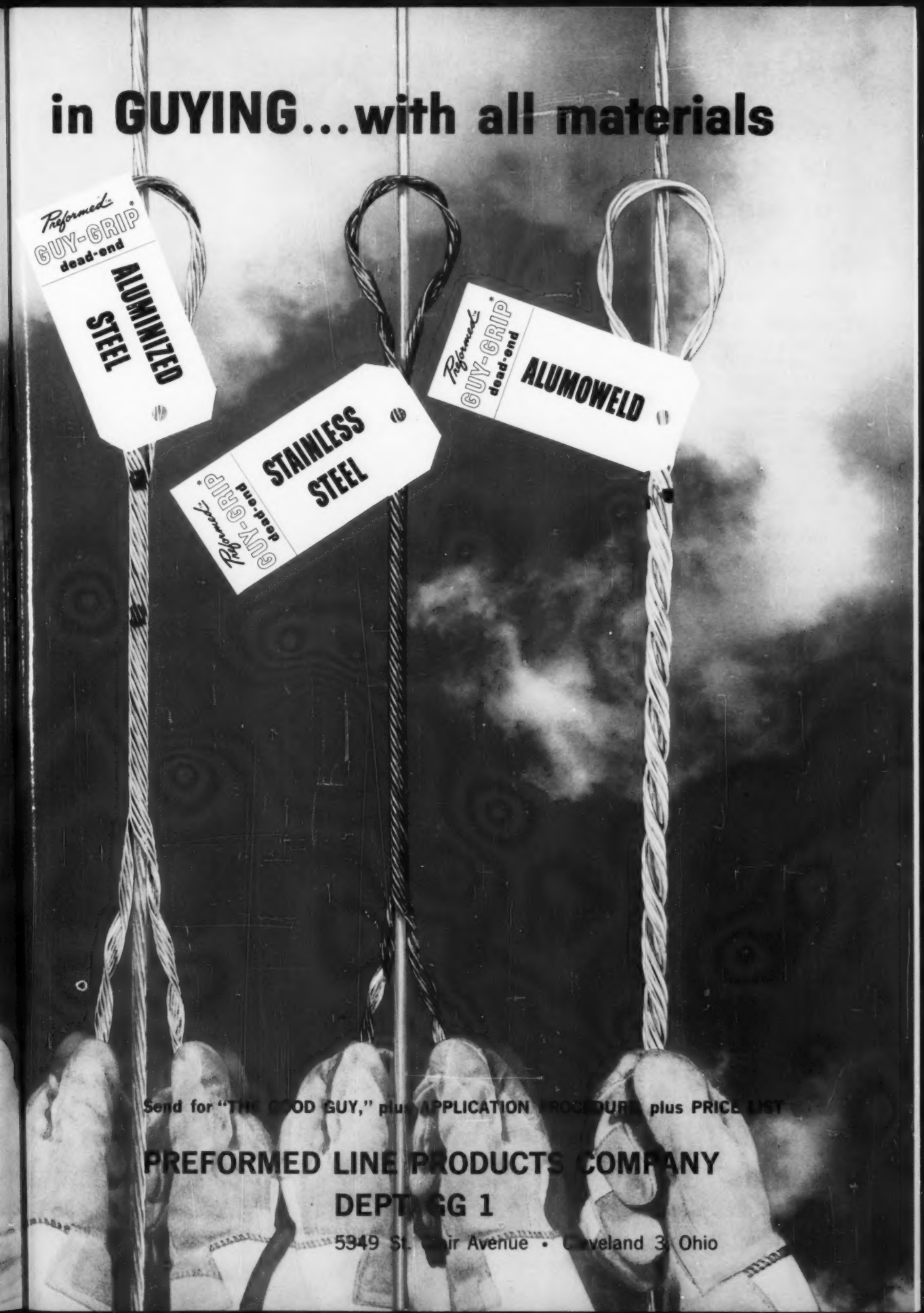
PATENTED—U.S. PATENT NUMBER 2,761,273
T.M.
You can look up to Preformed


in GUYING...with all materials
Preformed GUY-GRIP dead-end
ALUMINIZED STEEL
Preformed GUY-GRIP dead-end
STAINLESS STEEL
Preformed GUY-GRIP dead-end
ALUMOWELD
Send for "THE GOOD GUY," plus APPLICATION PROCEDURE plus PRICE LIST
PREFORMED LINE PRODUCTS COMPANY
DEPT. GG 1
5349 St. Clair Avenue • Cleveland 3, Ohio

Dallas' NEW SOUTHLAND CENTER

supplied with 12,000 kva of electricity

Served by six Wagner Underground Network Transformers

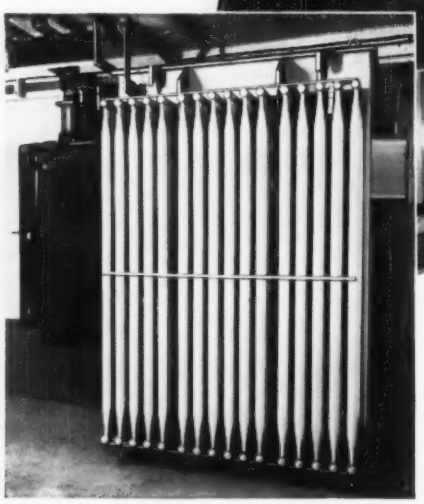
Dallas' fabulous new Southland Center consists of the 42-story Southland Life Tower, tallest building west of the Mississippi, and the 600-room Sheraton-Dallas Hotel. A "City within a City," the Southland Center is an enormous consumer of electric power. For example, there is a 6,450 ton electrically-driven air conditioning system—fourth largest in the world!

Dallas Power and Light Company, who supplies this power, has installed six 2,000 kva underground network transformers in the basement of the building to assure continuous electrical service to the Center. The transformers were supplied by Wagner.

Wagner Network Transformers are built for installations of this type. They have a low noise level . . . they are small in size to fit in close quarters, and now have a compact switch and panel radiators for smoother contour and easier maintenance.

Wagner makes a complete range of transformers for industrial and power company needs. Consult your nearby Wagner Sales Engineer about your power distribution program. There are Wagner branches in 32 principal cities.

Southland Center has 296 miles of electrical wiring . . . 15,800 lighting fixtures . . . 28 elevators . . . 8 escalators and an all-electric company cafeteria.



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ELECTRICAL . . . AUTOMOTIVE

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BRANCHES AND DISTRIBUTORS IN ALL PRINCIPAL CITIES

It's Time for Electric Heating to Grow Up!

(*Continued from p 209*)

adoption by the industry now:

> That type of house construction and degree of weatherproofing which gives the lowest total for yearly electric bills plus annual mortgage payments.

Will this make sense to the purchaser of a new home? His annual out-of-pocket cash will be less than under the "6-4-2" standard (see table to the right.)

Will this make sense to the project home builder? In securing FHA approvals of loans, a mortgagor with a lower income can qualify. That is because both annual mortgage payments and heating bills are considered, and the total will be less with heavier insulation. Further, a higher resale valuation is warranted, which also affects the FHA rating. Owners are becoming increasingly sensitive to the effect on resale value.

Probably this suggested standard can be stated in terms of inches of insulation (or "U" values) for about three broad zones of the country, but cannot be so stated for the entire country. However, if the energy and capacity saving for summer air conditioning be taken into account, and the increased summer comfort even without air conditioning, we may find that the zonal differences will be less than off-hand guesses seem to indicate.

Consider Energy's Future Price

Aside from other considerations, some weight should be given to conserving our energy sources, and to the future price of energy . . . which will undoubtedly increase. We build our homes for the future, as well as for next year.

Table above is an example of insulation economics for a 1200-sq ft home, in an area having a design temperature of 15F below zero and 7,200 degree-days. The use of 12 in. of ceiling insulation, and 2 x 6 studding walls with 6 in. of insulation, may astound many readers.

The calculations assume that the life of the house will be the life of the mortgage, or 20 years. Actually, house life is much longer, and after the mortgage is paid off there is a saving of $70 a year at 2¢, or $35 a year at 1¢ electricity.

The Author Sees These Savings With Heavier Insulation

	Insulation 6-4-2	Insulation 12-6-6	Saving with 12-6-6
Kwhrs per year for heating	13,090	9,600	3,490
Annual electric bill for heating, @ 2¢ per kwhr	$262	$192	$70
Annual payments on 20-yr 6% mortgage for $15,000 for house with 6-4-2 insulation	$1,291		
Annual payments on mortgage for $15,232* for house with 12-6-6 insulation		$1,311	($20)
Total	**$1,553**	**$1,503**	**$50 saving**
If the price of energy were but 1¢ the heavy insulation still shows a saving:			
Annual electric bill, @ 1¢	$131	$96	$35
Mortgage payments	1,291	1,311	($20)
Total	**$1,422**	**$1,407**	**$15 saving**

*The $232 is the difference between the higher first cost of $326 for extra structural and insulation costs, and $94 lower first cost of heating equipment due to the lesser capacity needed.

Best Design of Heating Equipment

Without knowing the exact answer to Question 1, it is apparent that, with much lower heat losses to meet, electric heating equipment may be designed with lower watt-densities than at present. This should produce:

- Better heat distribution and better comfort;
- Minimum hazard from fire;
- Heating elements of low temperature, having a life expectancy equal to that of the structure;
- Avoidance of all uncomfortable high-temperature radiant heat sources.

For example—

Using electric baseboard units, a 15 ft x 25 ft living room with 50% of the exposed walls double glass, and "6-4-2" insulation, requires about 150 w/ft of baseboard for —15 F design temperature. Increasing the insulation to "12-6-6" reduces the watt-density requirement to 115 w/ft.

For the same climate the annual operating cost at 1½¢ a kwhr, is 38¢ per sq ft of double glass exposure. At 2¢ electricity this annual cost is 51¢ a sq ft.

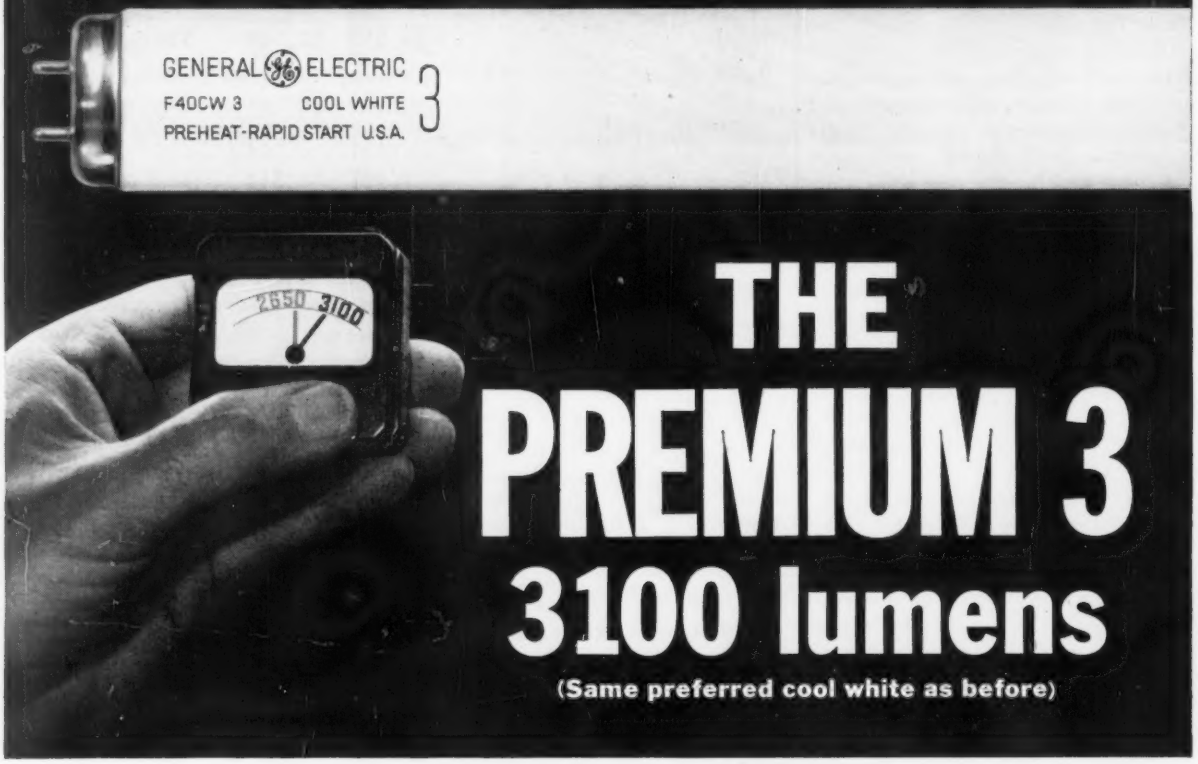
With a more conservative use of glass (100 sq ft of the total 375 sq ft of exposed wall), which is more representative of homes to be electrically heated, the watt-densities required are 128 w/ft for 6-4-2 insulation, and 91 w/ft for 12-6-6 insulation.

Today's baseboard heaters have watt-densities of about 250 w/ft, with extremes up to 375 and down to 160. Obviously most of this equipment was designed for houses with considerably less insulation than 6-4-2. What we need is equipment designed to fit the yet higher insulation standard warranted by the savings in electric bills.

Ceiling cable installations, being tailor-made for each house, can readily accommodate the lower heat losses. In fact, this will lower plaster

(*Continued on p 215*)

General Electric announces the most efficient and economical 40-watt fluorescent you can buy



THE PREMIUM 3
3100 lumens

(Same preferred cool white as before)

Gives customers 17% more light from present fixtures!

G-E PREMIUM 3 Lamps give your customers the lowest over-all cost of light of any 40-watt lamp. Three new innovations provide added light worth more than the cost of the lamps themselves: 1) more efficient phosphors, 2) newly designed electrode mount, 3) new current-carrying gas mixture.

G-E PREMIUM 3 Lamps, the latest example of General Electric's lamp development, give your customers more for all their lighting dollars. G-E *Premium 3* Lamps operate on Rapid Start or Pre-heat (starter-type) circuits—and will be widely used to make existing systems deliver more light at virtually no added cost. Available in limited quantity in May, list price $1.45.

On Rapid Start circuits G-E *Premium 3* Lamps have a 7,500 hour rated life; 5,000 hours on Pre-heat circuits. Write for the whole story on this new dimension in fluorescent lighting. General Electric Co., Large Lamp Dept. C-926, Nela Park, Cleveland 12, Ohio.

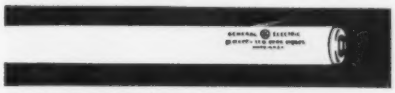
Progress Is Our Most Important Product

GENERAL ELECTRIC

G-E PREMIUM 3

now joins these other outstanding "firsts" in fluorescent lighting . . . all introduced by General Electric!

1938—FIRST FLUORESCENT. This was the year General Electric announced the first practical fluorescent—a revolutionary new and efficient lighting tool.



1939—FIRST 40-WATT. Predecessor to today's highly efficient 40-watt fluorescents—opening the way for the new G-E *Premium 3* Lamp.

1946—FIRST SLIMLINE. This single pin lamp, the first practical 8′ tube, provided more attractive lighting systems, quicker lamp changing, instant starting.

1952—FIRST RAPID START. This G-E development brought faster, flickerless starting *without starters*—and cut maintenance costs, too.

1954—FIRST HIGH OUTPUT. Delivered half again as much light as slimlines, more light from equal fixtures, for big investment savings.

1956—FIRST POWER GROOVE. This revolutionary, grooved lamp gave 2½ times the light of slimlines; saved 5-20% on initial investment.

1959—NEW POWER GROOVE. The most powerful fluorescent you can buy. Double row of grooves helps increase light output 12%, to 15,000 lumens for 8-foot length.

Progress Is Our Most Important Product

GENERAL ELECTRIC

Electric Heating, Grow Up!

(*Continued from p* 213)

temperatures and thereby reduce the heat loss through the ceiling.

Provision for Air Handling

Electric heating will bring maximum benefits to the customer when it is coupled with an air handling system, making initial provision for or planned later expansion to include:

- Continuous circulation of air, avoiding stagnation and stuffiness under all weather conditions;
- Continuous intake and tempering of fresh air at a measured rate.
- Electrostatic cleaning of air;
- Humidification or dehumidification as needed;
- Summer air conditioning.

Tempered Air Cuts W-Density

When advance preparations for air conditioning are not made at the time of construction, attic installation of ductwork may be the only practical solution. Because of the higher winter heat losses inherent in that kind of a duct system, it is a poor answer for the electrically heated home.

With an air handling system which includes central duct heaters to temper the fresh air intake, the watt density required for the inspace heaters is further reduced, perhaps another 30%. This arrangement automatically provides zoned cooling during the heating season, for the room temporarily is in a heat gain condition.

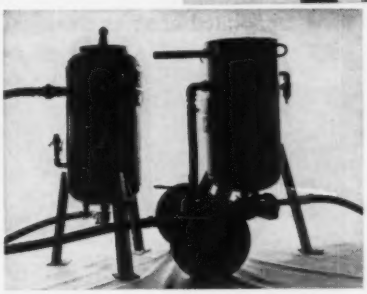
Air Handling Is a Must

In spite of the trade complications which come with providing an air handling system, we may as well face the fact that electric resistance heating alone will not long continue to meet the expectations of the customers. It is not in itself capable of giving some of the high-quality results of the better fuel-burning systems because air-handling is necessary for maximum comfort.

The home owner can no more do without the services of the tinsmith than he can do without the services of the electrician.

It is time for electric space heating to "grow up", and deliver the many consumer benefits of which it is capable.

U-AUTO CLEAN'ER



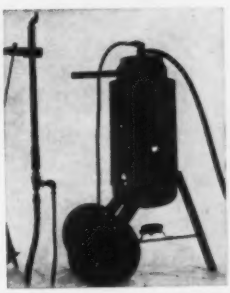
Cleans 'em HOT
Cleans 'em DRY

U-AUTO DRESS'ER

Dresses 'em HOT with a *thin* layer of dispersed silicone gel.

—or—

A *thick* layer of MELTED silicone grease.



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Compton 3, Calif.

Please send further information

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City..... Zone.... State.....

NEES Names Four Engineers to New Posts

Four engineers at New England Electric System have taken new assignments. Ogden E. Sawyer has been appointed chief engineer, succeeding Edward W. Dillard who becomes consulting engineer. Herbert R. Stewart, former system electrical engineer, has been named senior engineer, and Harris Barber assumes Stewart's post.

SAWYER

Sawyer joined the system as assistant meter tester with Narragansett Electric Co in 1932. In 1943 he was loaned to the Division of War Research at Columbia University. In 1945 he returned to Narragansett Electric, becoming district engineer in 1951. He became assistant chief engineer in 1958.

Stewart spent nine years with Westinghouse Electric Corp before joining NEES as protection engineer in 1934. He became system electrical engineer in 1948.

Dillard was assistant electrical engineer from 1918 to 1928, electric engineer for the next 20 years, and then chief engineer.

STEWART

Barber became electrical design engineer in 1934, and assistant electrical engineer in 1948.

WERNER

AVERETT

New Sales Managers Named

Clarence F. Werner has been named sales manager of Brockton Edison Co. He succeeds James E. Averett, now sales manager of Savannah Electric & Power Co.

Werner started with Brockton Edison in 1928. In 1935 he went with Virginia Electric & Power Co, and in 1937 joined Blackstone Valley Gas & Electric Co.

Averett has served as Brockton Edison sales manager since 1945. He returns to the company where he had previously served as sales manager.

DeBard To Join Reddy Kilowatt

Davis M. DeBard will join Reddy Kilowatt, Inc., on September 1 as a consultant to Ashton B. Collins, president. DeBard resigns June 30 from Stone & Webster Service Corp where he has been vice president since 1931.

DeBard started his career with Brockton Edison Co upon graduation from Cornell University. He served with Brockton Ed for ten years as a collector, lighting salesman, and power salesman. His next position was assistant treasurer of Walk-Over Shoe Co where he spent five years. While there he electrified the entire plant.

In 1926, DeBard joined Stone & Webster Service Corp in Boston heading up the sales promotion activities of all the operating companies. He transferred to the New York office in 1931.

PERSONAL BRIEFS

George W. Miller has been elected treasurer of Philadelphia Electric Co, succeeding **C. Winner** who retired.

Elmer O. Dowies, superintendent of Arizona Public Service Co's Saguaro Power Plant has been named superintendent of the utility's Ocotillo Power Plant now under construction in Tempe.

C. B. Miller, Jr., has been promoted to manager of distribution engineering and operation for Duke Power Co.

Consolidated Edison Co of New York has elected **John J. Crane** assistant secretary and **Harvey G. Clifford** has been named assistant treasurer.

Warren A. Greten has been appointed assistant plant superintendent at Connecticut Light & Power Co's Devon Steam Generating Station.

Philip P. Ardery has been named chief legal counsel for Kentucky Rural Electric Co-operative Corp and East Kentucky Rural Electric Co-operative Corp.

Potomac Light & Power Co has added **Daniel M. Staubs** and **Charles Rodig** to the merchandise staff.

Jersey Central Power & Light Co and New Jersey Power & Light Co has made the following appointments: **Russell W. Aul,** secretary; **Raymond D. MacFee,** comptroller. **William E. Kuhns,** secretary-treasurer of General Public Utilities, was elected a director, and **Paul Lenhart** was elected assistant treasurer of New Jersey Power & Light.

Wisconsin Utilities Assn has installed the following officers: **Stuart V. Willson,** Northern States Power Co (Wisconsin), president; **Harry I. Miller,** Wisconsin Public Service Corp, vice president; **Lester M. La Porte,** Wisconsin Electric Power Co, treasurer.

Ray Hicks has been named engineer for Arkansas Power & Light Co in the Morrilton office, succeeding **Bill**

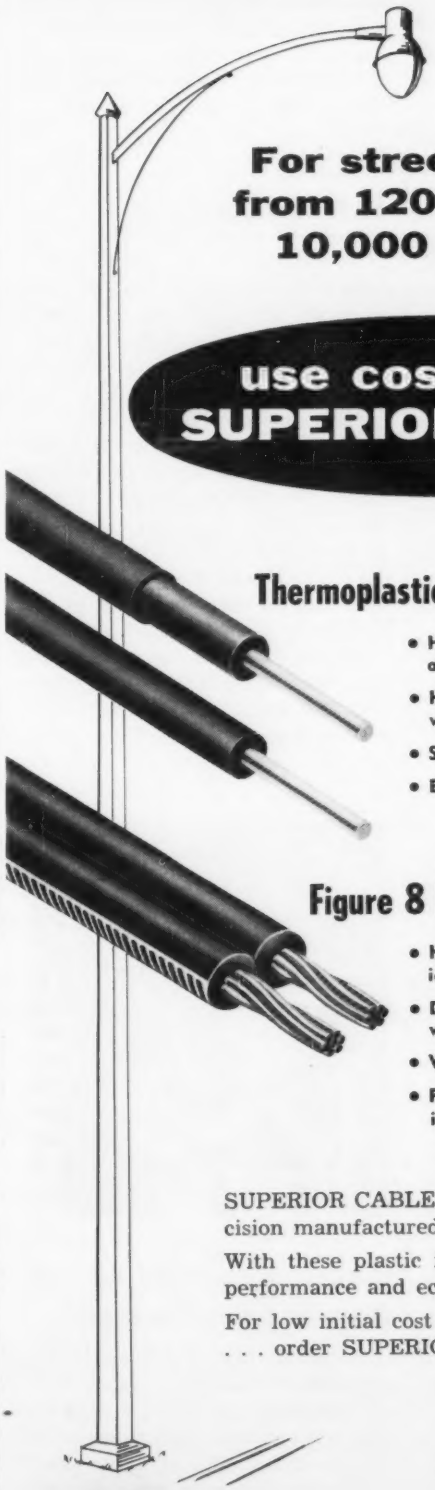

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Figure 8 Pole and Bracket Cable

- High resistance to abrasion, mechanical damage
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SUPERIOR CABLES are quality-engineered, precision manufactured and thoroughly tested.

With these plastic insulated and jacketed cables, performance and economy go hand in hand.

For low initial cost . . . for less maintenance cost . . . order SUPERIOR CABLES!

For complete information and prices, write

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SUPERIOR CABLE CORPORATION

Hickory, North Carolina

3765

Stacks who was appointed customer service representative. Stacks replaces **Ben Clark** who moved to Pine Bluff as commercial sales representative.

Indiana & Michigan Electric Co has named **Dale E. Norris,** safety supervisor of the South Bend Division; **Maxwell R. Harrell,** division senior engineer at Deer Creek; **Wayne A. Frost,** South Bend district commercial and industrial sales supervisor; and **John R. Ender,** Buchanan district commercial and industrial sales supervisor.

V. S. Casebolt has been appointed assistant vice president of Washington Water Power Co.

Ohio Valley Electric Corp has made these changes: **W. Frank Neff** to superintendent of electrical operations; **James G. Cox,** executive assistant to the vice president; **John S. Foster,** staff engineer-production; and **Walter M. Cornett,** acting director of personnel.

Everett P. Welch has been appointed manager of Pennsylvania Power & Light Co's engineering services dept. He succeeds **William H. Stang** who retired after 40 years of service.

OBITUARY

John M. Gregg, 70, retired division engineer for the Central Illinois Public Service Co . . . **Bert L. Wardell,** 69, retired superintendent of transmission, distribution, and meters for the Niagara Mohawk Power Corp . . . **Raymond Hampel, Sr,** 52, vice president of the Brazos Electric Power Co-operative, Waco, Tex. . . . **Leo A. Mayo,** controller of the Connecticut Light & Power Co . . . **Fernard C. Weiss,** 67, retired vice president in charge of engineering and construction and a director of Alabama Power Co . . . **S. I. McElhoes,** former vice president and general manager of Southwestern Light & Power Co.

Busby Made Chairman of Public Information Program

Jack . K. Busby, president of Pennsylvania Power & Light Co, has been elected chairman of the Steering Committee of the Electric Companies Public Information Program. He succeeds E. M. Naughton, president of Utah Power & Light Co, who served a two-year term as chairman.

Charles B. Delafield, vice president of Consolidated Edison Co of New York, has been named chairman of the Finance Committee.

Hatfield Appointed VP and General Sales Manager

Robert H. Hatfield, formerly vice president in charge of manufacturing, has been appointed vice president and general sales manager in charge of domestic sales for Combustion Engineering, Inc. He will report to Donald S. Walker, vice president and director of sales.

Hatfield joined Combustion in 1934. He served as assistant general sales manager and general manager of the western division before being elected a vice president.

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Prompt Stock Shipment
RENUBILT MOTORS - GENERATORS
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1—1000 kva, Standard, 3/22900/2400/4160Y
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POSITIONS VACANT

Relay And Meter Test Engineer. Graduate EE with minimum 6 years experience meter and relay testing and relay coordination with operating utility. Must calculate system short-circuit conditions, prepare relay coordination curves, test and adjust relays, test and adjust watthour meters and perform general system testing and trouble shooting for small but fast-growing utility in Middle East. Ability organize test section, formulate test procedures, train test personnel and specify operating and test equipment is essential. Carrier system and two-way radio experience desirable but not essential. Salary $16,000 to $17,000 with two-year contract and other benefits. P-1838, Electrical World.

Transformer Designing Engineer, who is capable of designing oil cooled, electrical power transformers, up to 1000 KVA. Location New Jersey. New company going into business. P-1880, Electrical World.

Engineering Assistant. Need sound basic elect. education plus distribution design experience. Opportunity for further college education. Send resume, and salary requirements first letter. Castle Engineering Co., 16 Leland Ave., Columbus 14, Ohio.

Field Sales Manager—Established, aggressive, growing Southern manufacturer of products for the electrical industry (OEM's and utilities) seeks man qualified to supervise and work with nation-wide sales organization. Applicant must be good organizer, have executive abilities, and be able to train and inspire field sales force. Electrical Engineering or Mechanical Engineering degree desirable. Excellent salary, bonus and fringe benefits. Ideal working conditions. Give full details on first reply. P-2002, Electrical World.

SELLING OPPORTUNITY OFFERED

Representative wanted for manufacturer of street lighting equipment, pole line specialties. Full particulars. RW-9821, Electrical World.

POSITION WANTED

Licensed Boiler Operator Desires Job; General Maintenance; College Degree. John Radovic, 313 So. Pine, Hamburg, Ark., Ph. ID 3-5328.

U. S. Government

Sealed bids will be received in the office of the Engineering and Construction Director, Panama Canal Company, Balboa Heights, Canal Zone, until 1:00 P.M., E.S.T., August 14, 1959 and at that time publicly opened for the following: Furnishing and installing between 21 and 39 electric towing locomotives and 3 electric cranes for use on Panama Canal locks, to replace the existing electric locomotives and cranes. Plans and specifications are available for examination in the Procurement Office, Panama Canal Company, 21 West Street, New York 6, N. Y. These data may be obtained upon payment of $25.00 deposit which will be refunded when data are returned. For further information, contact this office. Telephone Bowling Green 9-5380, extension 73. Reference: PC 59-71.

SEARCHLIGHT continued on opposite page.

Electrical Construction Engineer

Leading engineering firm, main office, New York, requires graduate electrical engineer or equivalent for construction division.

Better than 8 years' field supervisory experience on installation, test, and start-up of major electrical equipment for large utility power plants and auxiliaries.

Please forward complete resume in absolute confidence.

P-1987, Electrical World
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Openings available for:

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Readers Forum

Transmission Brainstorm

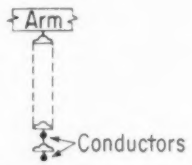
To the Editor:

For the consideration of your Electrical Dreamers Club, I would like to submit the following brainstorm:

With the advent of bundled conductors for transmission lines, why not insulate the two bundled conductors on one phase from each other with a small insulator. (See Fig. 1) Then at one end of the line, connect the generating station to the top conductor. At the other end of the line, connect the generation station to the lower conductor. (See Fig. 2) The two conductors on the same phase would now consist of a long distributed series capacitor which would cancel out part of the series reactance of the line. The impedance diagram might look like Fig 3.

If the spacing between the bundled conductors as shown in Fig. 1 does not provide enough series capacitance, consideration could be given to using a twin conductor insulated cable as the two conductors in one bundle. The insulation required would only be a small fraction of the phase to phase insulation. The closer spacing of the wires in the bundle would increase the series capacitance. Short circuiting switches would be required at each end to short the two conductors in a bundle for energizing the line and to short out for flashovers from lightning and load surges.

Fig 1



One Phase

Fig 2

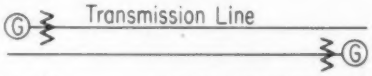
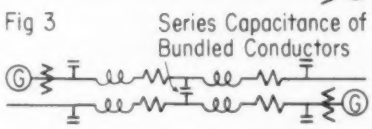


Fig 3



Advantages

Can transmit more power. Less I^2X loss in line. Can transmit some vars.

Disadvantages

Lightning flashovers. Load surge flashovers. Length of line is critical. Difficult to make load taps.

S. H. Pollock
Principal Engineer
KCP&L Co.
Kansas City Power & Light Company
Kansas City 10, Missouri

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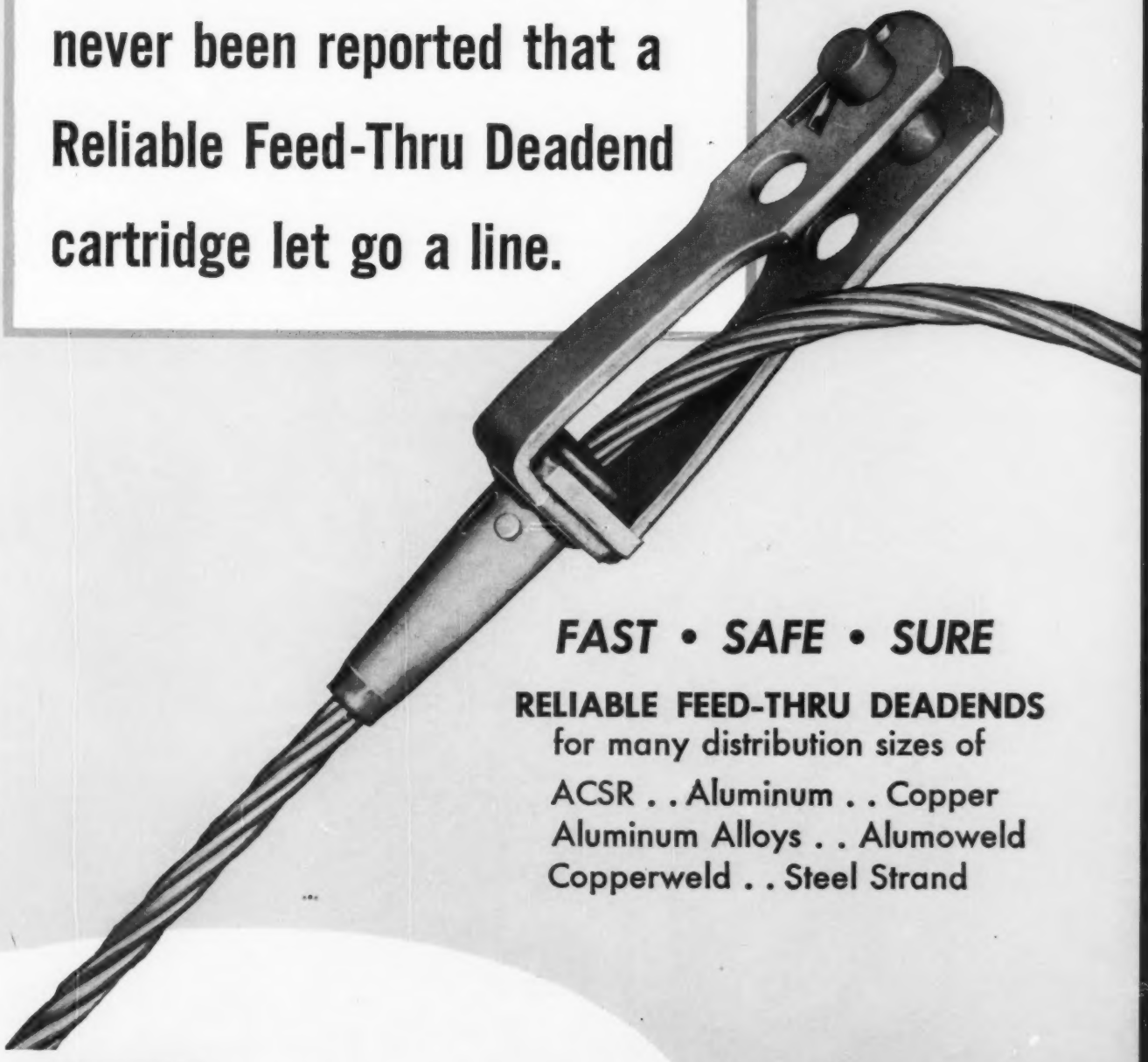

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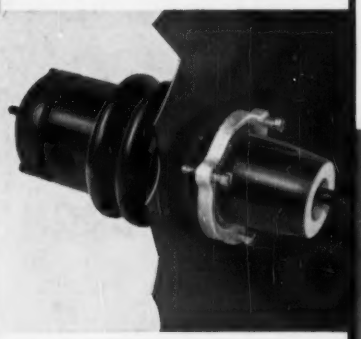
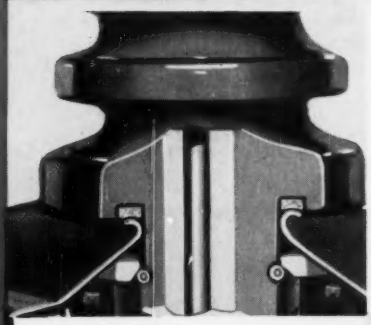
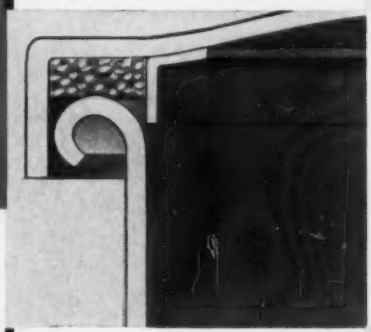
Sidewall bushings have the hardware keyed to the porcelain and the porcelain keyed to the tankwall, thereby preventing rotation of the bushing or any of its parts. Sidewall mounted high voltage bushings are equipped with a special cap for clamping the conductor in place quickly and safely without the use of tools.





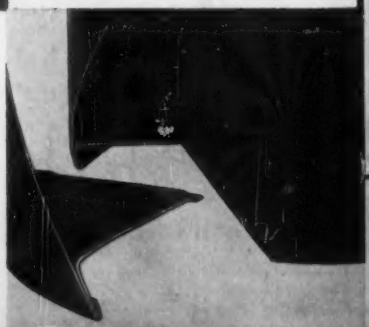
Cover mounted bushings are mounted on a smooth flange raised above the cover. This smooth rounded flange and the shape of the porcelain positively prevents the entrance of moisture. The contour of the flange eliminates corona at this point. Protective caps are provided for all cover mounted high voltage bushings.

Connectors are electro-tin coated and large enough to accommodate either the copper conductors specified by EEI-NEMA Standards or the ACSR equivalent. The large contact surface and a double-coil spring-type washer reduces conductor cold flow.



The tank and cover are die-formed assuring consistently accurate fit. The cover overhangs the tankwall and is dome shaped to shed moisture. The combination of a rolled top rim, cover overhang, cork-neoprene gasket and the gasket retainer positively seals the tank from moisture.

The base is welded to the tank wall. Then a sealing mastic is applied and the tank wall is rolled under the base flange to provide a triple thickness of metal. The tank and cover are painted by a hot-spray process and each coat is baked to form an extremely durable finish.



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